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NOTES FOR THE MONTH.

Farmers' Income Tax.

In his Budget Statement made on 1st May in the House of Commons, the Chancellor of the Exchequer proposed an important alteration in the assessment of farmers' profits for Income Tax under Schedule B. Assuming that the Chancellor's proposals become law, the profits for the year 1922-23 will be reckoned as equal to the rent or annual value of the land, instead of twice the value. The position will thus revert to what it was prior to the financial year 1918-19. One effect of this will be that many farmers whose assessed income, under the assessment that has been operative for the last four years, was sufficient to make them liable to Income Tax, will be exempt this year.

Furthermore, if a farmer can prove at the end of the year that he has not made a profit equal to the annual value of his land he can claim to pay on the actual profit, or alternatively he can elect to be assessed under Schedule D, that is, on the average of his actual profits for the three previous years. In both these cases, however, the production of accounts will be necessary in order to show what the actual profits were.

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Report of the Committee on Trade Boards.

their exhaustive review of the Trade Board system the Committee appointed by the Minister of Labour have examined at some length the fundamental reasons underlying the principle of a legal minimum rate of wages. Although the Committee consider that the State is entitled to take action to prevent the unfair oppression of individual workers, they are of opinion that it is impossible for a State-appointed body to regulate wages throughout an industry without causing a certain amount of injury both to employers and

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employed. The Committee observe that unfortunately for the Trade Board system many of the increases settled by the Boards came into operation when trade was falling.

Within certain limits an increase in cost of production can be "passed on" to the consumer, but in time the point is reached where the consumer ceases to buy and decline in trade follows, accompanied by discharge of workers—a result which is much more quickly reached where the trade is subject to foreign competition. On the other hand, in many cases Trade Boards have afforded protection to the good employer, able and willing to pay a reasonable rate of wages, from unscrupulous competitors who are prepared to take unfair advantage of the economic necessities of the workers. Speaking generally the Committee are of opinion that the Boards have succeeded in abolishing the grosser forms of underpayment.

The Committee are satisfied that the establishment of the Trade Boards has had a valuable indirect advantage in improving relations between employers and workers. In trades in which no machinery for joint negotiations previously existed, the working of the Trade Board Acts, by bringing the two sides together to discuss the wages question round a table, has in many cases enabled each side to understand something of the other's point of view, and has so contributed to the growth of more satisfactory relations between the two sides and has undoubtedly had the effect of strengthening the respective organisations.

Although the Committee consider that the Trade Board system should be retained, they express the opinion that the time has come when Parliament should determine certain general principles upon which the Boards should work. In the Committee's view a clear distinction should be drawn between the use of the coercive powers of the State to insist on the payment of a subsistence wage, and the use of those powers to secure the payment of higher rates of wages for skilled workers. "It is one thing to say that an employer shall not pay an adult worker a sum insufficient for his maintenance" . . . "but any further regulation of wages should be left as far as possible to the processes of negotiation and collective bargaining." On these grounds the Committee make the somewhat revolutionary proposal that Trade Boards in future should have two quite separate functions in fixing rates of wages.

It is recommended that a Trade Board should in the first place fix a general minimum rate of wages applicable to the lowest

grade of worker in the industry. This rate of wages should approximate to the subsistence level in the place where the workers live and which the trade can bear. Rates of wages fixed on this principle should, in the Committee's opinion, continue to be enforceable with all the authority of the law. Having thus secured for all the workers in a particular trade a legal subsistence wage, the Committee consider that the fixing of special rates of wages for more skilled classes of workers in the trade should be a matter for agreement between the employers' and workers' sides of the Trade Board, who should come to their decisions in these matters without the help of the "appointed" members.

The Committee further make an important recommendation that these special rates of wages, when fixed, should not be automatically enforceable by law, but that the Trade Board should have power, if the two sides agree, to ask the Minister of Labour to confirm such rates on the principle laid down in the Corn Production Acts (Repeal) Act, which means that the confirmed rates would become an implied part of the terms of contract of all the workers concerned, and would be enforceable only by civil proceedings taken by the workers themselves (and not, as in the case of the subsistence minimum wage, by quasi criminal proceedings taken by the Government).

In examining the question of permits of exemption the Committee point out that the present Trade Board Acts do not provide for permits being issued to a "slow worker," *i.e.*, the person who, while not subject to any infirmity or physical injury, is yet incapable, owing to some constitutional defect or to age or some other cause, of earning the minimum wage fixed for the ordinary worker of his class. In the Committee's opinion the power of a Trade Board to grant permits of exemption should not be confined to cases of physical or mental infirmity, but should be widened to include incapacity from any cause. The Committee add that in view of the unavoidable delay in considering applications for permits, Trade Boards should have power in granting permits to make them operative from the date of application.

Another very interesting recommendation of the Committee is that Trade Boards should have power to fix a series of minimum rates to come into operation contingently on the occurrence of specific events. This power obviously would be very useful to a Board which had decided on the principle of basic rates of wages and which would, having once dealt with the matter, be

prepared to leave the rates to rise or fall for a period in accordance with the official cost of living index figures.

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Destruction of Rats in 1921.

WHILE steady progress was made during the period 1st April, 1921, to 31st March, 1922, with regard to the administration of the Rats and Mice (Destruction) Act, 1919, by County and Metropolitan Boroughs, Port Sanitary Authorities, and Town and District Councils to which powers have been delegated by County Councils, the year was marked by many changes in respect of the administration of the Act by County Councils. This was due to the many efforts made to achieve economy, which compelled some Counties to dispense with the services of a whole-time Rat Officer, even although those services were shown to have been of great assistance to occupiers throughout the country, and to have led to the proper observance of the Act. Moreover, the repeal of Part I of the Agriculture Act, 1920, with the subsequent termination of the appointments of Cultivation Officers, also affected the situation, as these officers had, in many cases, been appointed to carry out the work of Rat Officers in connection with their ordinary duties.

There are now 559 Local Authorities responsible for the administration of the Act, *i.e.*, 63 County Councils, 82 County Boroughs, 60 Port Sanitary Authorities, 28 Metropolitan Boroughs, the City of London and 325 Minor Authorities, of which, according to records in the possession of the Ministry, only 16 County Councils (3 of these Councils have delegated powers to all Town and District Councils), 5 Port Sanitary Authorities and 91 Minor Authorities have not yet appointed an officer responsible for the administration of the Act. In addition, most of the Local Authorities that have not appointed Rat Officers, are taking some steps to secure the observance of the provisions of the Act, although their action has not taken a very concrete form. In view of the urgent need for economy the Ministry has ceased to press for the appointment of *whole-time* Rat Officers, but is suggesting that some existing officer of the Local Authority should undertake, in connection with his ordinary duties, the task of enforcing the provisions of the Act so far as it may be possible.

A National Rat Week was held during the week 31st October to 7th November last, as a result of which at least 23 Counties,

35 County Boroughs, 5 Port Sanitary Authorities, 7 Metropolitan Boroughs and 57 Minor Authorities, took action. On the other hand no special action was taken by 85 Authorities, the reason given in 33 instances being that rat destruction was a routine matter throughout the year, and that special action was, therefore, not considered necessary or desirable. In 30 cases no reason at all was given as to why no steps had been taken to organise a Rat Week. Of the 127 Authorities which informed the Ministry that some action was taken, 44 took considerable pains to give the week great publicity, while 33 gave their own property, sewage farm, dumps, etc., special attention. On the whole, the National Rat Week may be said to have achieved its purpose in stimulating interest in rat and mouse destruction, and bringing once more before the public the fact that they are responsible for the destruction of any rats or mice infesting land or buildings in their occupation.

During the year, 734 cases of infestation were brought to the notice of the Ministry, and in respect of these infestations action was taken by the responsible Local Authority in 388 cases, and the Ministry's advice was followed with satisfactory results in 212 cases. During the year 1920, these figures were 317, 135 and 37 respectively. The increase in the number of cases received during the year 1921 over those received during the previous year, is partly due to the fact that, for the first six months, the three assistant Technical Officers of the Ministry were very active throughout the country, and brought to the notice of the Ministry infestations that would otherwise not have been reported. The termination of their engagements on the 31st December has greatly reduced the possibility of securing the proper administration of the Act, as, without definite evidence of infestation, the Ministry cannot bring pressure to bear upon backward Local Authorities.

During the year, 10½ tons of rat destructive bait were prepared at the Ministry's Factory. In addition the work in the Rat Research Laboratory greatly increased, especially in respect of the number of experiments performed, and was productive of much useful information. Several promising lines of investigation were developed. The actual number of samples received or examined was 186. In addition to chemical examinations 1,087 experiments were carried out on rats.

The analysis of these experiments would probably prove too technical to be of general interest, but it may be stated that

not only were various baits and proprietary poisons tested, but many experiments were conducted to elucidate the active agent in red squill and to obtain more certain information as to the minimum lethal dose, and the suitability of various squill poisons. Several series of experiments were also carried out to investigate the action of barium carbonate and other sorts of barium, but the results proved unexpectedly variable, and it is difficult to draw from them any satisfactory generalisation. Experiments were continued on the question of the palatability of various vehicles, especially cereals.

The number of premises treated by bait from the factory in 1921-2 was 776 (compared with 295 in 1920-1), and the number of treatments applied amounted to 1,644 (687 in 1920-1). In many cases the initial treatment resulted in the premises being completely freed from rats and mice, and 326 cases have been recorded in which treatment was very definitely successful. In the other cases the application of the bait proved successful, and further treatment was requested.

It is regretted that owing to the closing down of the Rat Bait Factory and Research Laboratory the services rendered and the research undertaken will have to cease.

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The Suppression of Weeds.

THE part played by weeds in farm economy has long been recognised by practical farmers, and the Ministry has repeatedly directed attention to the subject since the year 1900, when the leaflet on Charlock was first issued. Since that date a widely distributed leaflet (*Weeds and their Suppression*) has given condensed information on the damage done by weeds, the manner of their distribution, and the general methods which may be brought into requisition in suppressing them. Other leaflets deal specifically with certain of the more troublesome weeds.

Weeds of different species vary considerably in their life history and general vitality, and hence in the amount of damage they are able to accomplish. The measures necessary for their eradication vary accordingly. Some wild plants are of so little consequence to economic agriculture that they may be neglected; other species are harmful if plentiful; others may, if they once obtain a sure footing, prove an actual scourge, and involve very great labour, expense and loss; while yet others are injurious or even deadly poisonous to farm stock.

It cannot but be of great value to farmers and gardeners to be in a position to recognise weeds, and to have a knowledge of their life history and habits. Such a knowledge of a given weed will at the outset often enable one to judge whether it is likely to cause serious trouble, and will largely indicate what type of protective and remedial measures may most successfully be adopted.

New leaflets on Ragwort and Spurrey have recently been issued by the Ministry, and other weed leaflets have been revised. In order to place information on weeds in the hands of farmers and others in a convenient form, the whole of the leaflets so far issued have been brought together in a small volume of 86 pages.* This volume deals with seven species of thistles, three species of couch or twitch, charlock, dodder, broom-rape, coltsfoot, docks and sorrels, yellow rattle, spurrey, ragwort, meadow saffron, corn marigold, goosefoot, corn cockle, stinging nettles and poppies. It also includes general leaflets on weeds and their suppression, seed testing, and injurious weed seeds in grasses and clovers harvested for seed in Britain.

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Conciliation Committees in Agriculture.

SEVERAL agreements of the Conciliation Committees expired during the last month, but in most cases the Committees concerned have succeeded in arriving at new agreements to operate during the next few months. In Anglesey, where no agreement has existed for the last six months, the negotiations have at last resulted in a settlement, and the Committee have now arrived at an agreement to cover the half-yearly period up to 13th November.

The total number of agreements in operation on 22nd May was 45.

The agreements made since 22nd April are as follows:—

Area.	*Period.*	*Wages.*	*Hours per week.*
Beds and Hunts.	Up to 6th Oct., 1922	7½d. per hr. Guaranteed week of 50 hr.	
Cheshire - -	„ 30th Sept. „	36/-. Weekday overtime 9d. per hr. Sunday employment 10d. per hr.	54

* Collected Leaflets on Weeds, price 8d. post free, from the Ministry's Offices, 10, Whitehall Place, London, S.W.1.

Area.	*Period.*	*Wages.*	*Hours per week.*
Durham - -	Until such time that one side gives notice of alteration.	35/-. Weekday overtime 10d. per hr. Sunday employment 1/- per hr.	50
Leicester—Ashby Bosworth, Hinckley and Atherstone.	Up to 30th Sept., 1922	34/-. Weekday overtime 8d. per hr. Sunday employment 1/- per hr.	54
Somerset - -	„ 30th Sept., „	32/-. Weekday overtime 8d. per hr. Sunday employment 1/- per hr.	54
Stafford - -	„ 30th Sept., „	7½d. per hr. up to 60 hr. per week. Guaranteed week of 50 hr. Employment in excess of 60 hr. and Sunday employment 9d. per hr.	
Wiltshire	Up to 29th Sept., 1922	30/- All overtime 8d. per hr.	52
Anglesey	Up to 13th Nov., 1922	30/-	56
Brecon and Radnor	„ „ 1st „ „	7½d. per hr. up to 60 hr. Guaranteed week of 52 hr. Employment in excess of 60 hr. and Sunday employment time and a quarter.	„

Full particulars of the agreement for any particular area will be furnished on application to the Ministry.

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The Agricultural Index Number.

THE average of the prices in April of all descriptions of agricultural produce at markets in England and Wales was 68 per cent. above the pre-war level, as against 82 per cent. in March and 141 per cent. in April last year.

The percentage increase during each month from January, 1919, as compared with the pre-war years is shown in the following table :—

Month.	Percentage Increase. 1919.	1920.	1921.	1922.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
January	148	213	186	77
February	150	205	172	83
March	150	199	158	82
April	153	199	141	68
May	132	169	112	—
June	128	164	102	—
July	141	174	100	—
August	138	177	116	—
September... ...	148	181	105	—
October	166	191	90	—
November... ...	182	197	84	—
December	207	194	82	—

The fall in April is mainly due to the decrease in the price of milk, the average price received by milk producers, after allowing for the improvement in contract prices under the recent agreement with distributors, being only about 21 per cent. above the average of the years 1911-13, as compared with 120 per cent. in March. A decline normally takes place at this period, but this year it has been considerably greater than usual.

Apart from the fall in milk prices the outstanding feature of the markets during April was the continued rise in the price of fat sheep, which rose from 60 per cent. above the pre-war value in January to 83 per cent. in February, 120 per cent. in March, and 143 per cent. in April. Fat cattle and pigs, and also poultry, advanced slightly in value during April. Wheat, barley, oats and hay were somewhat cheaper, but potatoes registered a decided advance towards the end of the month, which is shown by the monthly index number at 126 per cent. above the pre-war level. It is with potatoes that the greatest change from April to May seems likely to occur, as the April advance has since become accentuated.

Practically all descriptions of feeding stuffs were purchasable at rather easier rates during April, milling offals being about 42 per cent., maize 45 per cent., and oilcakes 62 per cent. above the average of the years 1911-13. Hardly any change was recorded in prices of fertilisers, although the strong demand for nitrate of soda resulted in an increase in price to an average of slightly over £15 10s. per ton for the month, or 46 per cent. above the pre-war price.

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Foot-and-Mouth Disease.

THE epidemic of foot-and-mouth disease in Great Britain, which started on 24th January last, appears now to have been practically mastered, as the number of outbreaks which occurred in the month from 23rd April to 21st May was only 20 out of a total of 1,099 since the beginning of the outbreak. Further sporadic outbreaks will probably occur, but it may be hoped that before long the country will be free from the disease, and all restrictions on the movement of animals withdrawn.

The total number of animals slaughtered in Great Britain in connection with foot-and-mouth disease since the first outbreak in January last is now 53,035, viz., 23,067 cattle, 20,596 sheep, 9,328 pigs, and 44 goats. These figures bear the following proportions to the total livestock population in Great Britain:—

Cattle	...	...	3.4 per thousand
Sheep	...	...	1.1 ,, ,,
Pigs	...	...	3.5 ,, ,,

The total cost of the operations against the disease amounts to approximately £755,000, of which £650,000 is the cost of compensation after deducting proceeds from the salvage of carcasses.

A more detailed statement on the subject appears on p. 285 of this issue of the *Journal*.

WISDOM AND FOLLY OF ANCIENT BOOK-FARMERS.

THE RT. HON. LORD ERNLE, P.C., M.V.O.

THE story of Joseph and his brethren has often been re-enacted in the protracted struggle between science and practice in agriculture. The elder sons of Jacob were plain practical men, experienced in the traditional routine of stock-rearing and corn-growing, wearing the weather-stained garments of their industry. It is possible that their younger brother, with his dainty clothes and indoor airs, had spoken disrespectfully of their lives and methods. He was a theorist. The day came when they saw their chance. "Behold this dreamer cometh!" So they stripped him of his variegated raiment and thrust him into a pit: but Joseph lived to save them from starvation and become their leader.

Yet it must be admitted that farmers have had good reason to distrust the pseudo-scientific advice of book-farmers. Before the end of the 18th century it was often indistinguishable from quackery, often false in its conclusions, often so mixed with folly as to be ridiculous, often based on hasty generalisations, often so extravagant in its promises as to arouse suspicion. The practical man opposed to the theories of would-be teachers his traditional routine of farm management. Its growth had been slow. It had been built up by protracted processes. Here and there some isolated agriculturist had, either by accident or experiment, chanced upon some new process or substance which increased the yield of his crops. Often the discovery would be ignored or forgotten, perhaps to be revived a century later. Sometimes it would be tried and confirmed by neighbours, spread over an ever-extending circle, and gradually incorporated in the general stock-in-trade of farmers. Tested experience of this kind is not easily disturbed. Why the given results follow may be unknown; it is enough that they are produced. Another process will not be adopted merely because it is new. Proof of better results is needed, and printed pages, especially when reading was a rare accomplishment, carry less weight than ocular demonstration. Seeing is believing. Sound sense often lies behind the conservatism of farmers. Mistakes in agriculture are costly, and sure returns are necessary where subsistence is at stake. The path of the

industry is strewn with the wreckage of those who have tried to grow rich by short cuts.

When true science began to speak, it had to remove a mass of suspicion engendered by the quacks who professed to speak in her name. Agricultural chemistry dates from the discovery of the composition of air at the close of the eighteenth century. Before that time the prejudices entertained by agriculturists against the unverified theories of book-farmers were often justified. They rested on a sure instinct. But rural ruts were so deep that they restricted the horizon. Old agricultural writers often recommended practices, now in universal use, a century before they were adopted. Their newfangled notions might have enriched the great-grandfather instead of the great-grandson. It may be interesting to collect a few illustrations. At least they emphasise the importance of keeping the eyes open. They show that some of the methods which from 1780 to 1870 made British agriculture famous, were anticipated and discussed in theory more than a century and a half before they were adopted in practice.

16th Century Literature.—The history of agricultural literature printed in English begins with the 16th century. In 1520 a Dutch bookseller, named John Dorne, carried on his business at Oxford. His trade was especially brisk at the two great annual fairs in May and October. In his day-book for that year he enters his sales. He sold one copy of "Husbandry" at one penny, and 3 copies of "Medecens voer Hors" at two pence each. Both books have disappeared. They have been thumbed out of existence.

The true father of the English literature of the farm is John Fitzherbert. He was a Derbyshire man, whose *Boke of Husbondrye* was printed in 1523. He did not presume to write on farming till he had accumulated a practical experience of 40 years. In this restraint he set a good example, which has not always been followed. A shrewd hard-headed man, he wrote a sensible book. Even in those days Derbyshire was famous as a horse-breeding county. Fitzherbert owned "60 mares or more." He knew the trade. He had as little faith in a horse-dealer or a "horse-leche" as in a "potycarye." "It were harde," he says, "to truste the best of them." His object in writing seems mainly to have been to demonstrate the superiority of a farm in separate occupation to a farm cultivated on the prevalent system of a tenancy in common. The few improvements which he suggests, and the arguments

by which they are enforced, strike us as antiquated. Both are now everywhere accepted: but it takes a heavy hammer and many blows to drive a nail through hearts of oak. It was two centuries and a half before they were recognised in practice. He insists on the advantages of a farm in individual occupation, divided by hedges and ditches into separate enclosures. In the first instance, he admits, the expenditure would be considerable, but it would pay any farmer with a twenty years' lease to make the outlay. He would get his money back with interest by saving the charges to common herdsmen and shepherds and the expenses of hurdles and stakes, by enjoying the longer season on the grass which the enclosed land allowed, and by gaining a greater choice of the time for marketing his calves and lambs. Enclosed land was better for the stock and better for the corn.

Fitzherbert did not believe in the abandonment of tillage or the adoption of ranching. He advocates mixed husbandry. If a farmer is to prosper, stock and corn must go together. A man, he says, cannot thrive by corn unless he has live-stock, and he who tries to keep stock without corn must either be "a buyer, a borrower, or a beggar." Though his resources were limited, though winter-keep remained an unsolved problem, and roots and artificial grasses were still unknown, he sees with a prophetic eye the verification of the maxim that "a full bullock-yard and a full fold make a full stack yard." If his advice had been heeded in the years 1480-1640, England might have escaped some of the misery which was caused by the transformation of common arable farms into sheep-walks, and by the consequent loss of employment, rural depopulation and destruction of houses and farm buildings.

Half a century later than Fitzherbert came Thomas Tusser, whose *Hundred Points of Husbandry* (1557), afterwards expanded into *Five Hundred Points of Good Husbandry* (1573), was written in doggerel verse. The book was so popular and so frequently republished that his name cannot be omitted. It is a valuable storehouse of information on existing practices, habits and customs. Tusser was a recorder rather than an improver. He makes no new suggestions, and has no theories to expound. With him begins the long line of agricultural writers, who failed in the business before they turned to literature, and thus strengthened the prejudice against book-farming. He was "a musician, schoolmaster, serving man, husbandman, grazier, poet—more skilful in all than thriving in his

vocation." He "spread his bread with all sorts of butter but none would ever stick thereon," and he is said to have died in the debtors' prison of the Poultry Counter. Probably his best remembered lines are:—

"At Christmas play and make good cheer
"For Christmas comes but once a year."

On one question, which from time to time is still disputed, both these old authors had made up their minds. Neither had any doubt that rooks were greater malefactors than benefactors. They charge them with preferring grain to grubs. Against pigeons, rooks and crows Fitzherbert proclaims a crusade. Tusser proposes to arm mothers with slings, and boys with bows and arrows, to drive away the marauders. Tudor England knew nothing of Board Schools.

Green Manuring.—One of the few suggestions made in these early books is that of green-manuring. Buck-wheat or "Brank" is suggested for the purpose. In Tudor times the expedient had a special value. It smothered the weeds, restored the humus, improved the texture of the soil, and provided manure when dung was scarce. Its use was the greater because the "seeds" crop, which serves similar purposes more effectively, was still unknown, but the danger of drying up the water supply limits its application to the more rainy districts. Buck-wheat is a quick grower and a good weed smotherer. It is for these reasons also recommended by Child (1651). It was sown in May and ploughed in in July. But Mortimer (1712) considered it a better practice to feed it to dairy cattle when it was coming into blossom. If allowed to seed and ripen, the grain was largely used for pigs and poultry. Milled for human food, it made a very white flour, which, in Stewart times, was highly esteemed for pancakes.

Child mentions other crops for green manure. Tares were, he says, so employed in Kent. He also recommends lupins, probably from his knowledge of Latin writers. The Romans were fully aware of their value before a corn crop, though the scientific reason for the richness of their fertilising qualities was a discovery of the last century. In this connexion may be mentioned another form of catch-cropping. William Ellis of Gaddesden, whose writings were famous in the first half of the 18th century, attributes the success of Hertfordshire farmers, among other causes, to growing tares on turnip fallows

to be grazed in May. Neither mustard nor vetches seem to have been used for catch-crops.

The Introduction of Clover, Grasses and Turnips.—Fitzherbert and Tusser knew no other country than England. Barnaby Googe was both a traveller and a translator. His *Foure Bookes of Husbandry* (1577) are translated from the Latin work of Conrad Heresbach published at Cologne, and a few pages are added of Googe's own observations on agricultural practices. The farming of the Low Countries, with which the book deals, was the most advanced in Europe. But, then as well as subsequently, English farmers looked on foreign innovations with suspicion. They had their full share of the national insularity. In this case they lost an opportunity. Googe gives the first hint of the new resources which, 200 years later, so marvellously enriched English farmers. He recommended not only the use of rape, but that of what he calls "Trefoil or Burgundian grass." "There can be," he says, "no better fodder devised for cattle." He also suggests, as supplying valuable food for live stock, the field cultivation of turnips. In the Low Countries they were extensively cultivated in the fields. In England, they were only just beginning to struggle into gardens as vegetables for human use to be "boyled and eaten with flesshe."

Whether Googe succeeded in converting any English farmers to the value of roots and grasses is unknown. As he gives a list of men whose farming was an object-lesson to their less advanced neighbours, it is possible that some may have tried the suggestion. If there were any converts, they were few. A dry year may have discouraged the experiment of roots. It may have stiffened the resistance of farmers to their introduction, and confirmed their stereotyped answer that the new crops would not grow in England because their ancestors had never grown them. It was not till more than 160 years later that the new resources began, on any general scale, to struggle into use in this country.

In clover and turnips new sources of wealth were thus offered to farmers as early as 1577. The want of winter-keep, for instance, accounted for the half-starved condition of English live stock, which only survived the winter as skin and bone. Here was a partial solution of the problem, and a means of carrying a larger and a heavier head of cattle and sheep. The new crops were destined to be the pivots of mixed farming.

Throughout the 17th century writers kept pegging away at turnips and temporary grasses. Little attention was paid. In the existing system of open-field farming there was no room for either crop. All the partners in the village farm enjoyed grazing rights over the fallows as well as over the other arable fields from corn-harvest to seed-time. Any enterprising man therefore who wished to grow turnips would grow them for the benefit of his neighbours. Up to 1773, it was impossible, without the assent of all the partners, to alter the rotation by which all were bound, or to interpolate either of the new crops. They were, therefore, out of the reach of open-field farmers. But occupiers of enclosed farms were almost equally backward.

Once again, seventy years after Barnaby Googe, attention was called to the methods of foreigners by an eyewitness. In a clear and concise treatise, Sir Richard Weston described (1645) the field cultivation of artificial grasses and turnips in Brabant and Flanders. At first the book circulated in manuscript, but it was printed in 1649-50, and again in 1651. Arthur Young, with characteristic enthusiasm, calls Weston "a greater benefactor than Newton," because he offered bread and meat to millions. But the times were unfavourable to progress. Traditionally, Oliver Cromwell interested himself in the introduction of the field cultivation of turnips. He is said to have paid a farmer named Howe £100 a year for being the first man to grow them successfully in Hertfordshire. Their cause, however, was not helped by the mountebank extravagance of writers like Adolphus Speed (1659), who commends them to farmers as the only food for cattle, sheep, swine and poultry, sovereign for conditioning "Hunting dogs," admirable as an ingredient in bread, supplying "exceeding good Oyl" and "excellent Syder," and yielding "two very good crops each year."

Other writers, on more moderate lines, urged the addition of temporary grasses and turnips to the resources of farmers. Andrew Yarranton, by his personal example and influence, succeeded, between the years 1653 and 1677, in establishing clover in Worcestershire and the adjoining counties. He was one of the most interesting men of the time. Starting as a linendraper's apprentice, he found the "Shop too narrow and short" for his mind. He took leave of his master, lived a country life for some years, served as a soldier in the Civil Wars, turned consulting engineer in 1652, and studied various means of bettering the condition of the country. Impressed

with the exhaustion of the "rye-lands" by "long tillage," he suggested clover as the remedy. His *Improvement by Clover* (1665) was "so fitted to the countrey-man's capacity that he fell on Pell-mell" and the new crop "doubled the value of the Land." Elsewhere, it was long before clover emerged "from the fields of gentlemen" into common use. Jethro Tull, writing in the reign of George II, says that, if advised to sow clover, "farmers would certainly reply 'Gentlemen might sow it if they pleased, but they (the farmers) must take care to pay their rents.'" In 1768 it was still unknown in many counties.

Equally strenuous was the opposition to turnips. It must, however, be remembered that at first they were sown broadcast. The name of the first man, Michael Houghton, who grew them at Hawsted in Suffolk in 1700, is preserved. "I introduced turnips into the field," wrote Jethro Tull of Berkshire, "in King William's reign; but the practice did not travel beyond the hedges of my estate till after the Peace of Utrecht" (1713). In 1716 they were still a source of wonder to the neighbours when they were grown in Scotland by the Earl of Rothes. On the other hand, they made their way more rapidly in Norfolk and Essex where they were established before 1684. Daniel Defoe, who began his tour of Great Britain in 1722, says that Norfolk was the county "where the Feeding and Fattening of Cattle, both Sheep as well as black Cattle, with Turnips, was first practis'd." Hertfordshire may perhaps dispute the claim. Defoe's *Tour* was published in 1738, the year in which died Lord Townshend, whose zealous advocacy of the use of turnips as the pivot of Norfolk farming, gained him the nickname of "Turnip" Townshend.

The Corn Drill.—None of the three Tudor agricultural writers who have been so far mentioned, were men of any scientific pretensions, even in the restricted sense in which the words can be used of our Elizabethan ancestors. Fitzherbert wrote his practical experiences. Tusser recorded facts. Googe reported foreign practices. Sir Hugh Plat was, in the alertness of his mental attitude, more akin to the scientific leaders of the 19th century. A man of an ingenious and inventive turn, he farmed near St. Albans. Among his suggested improvements was that of drilling, or, as it was then called, "setting" corn (1600). His attention was drawn to the advantages of the practice by accident. "A silly wench"

dropped wheat seeds into the holes meant for carrots. He claimed that, by dibbing wheat instead of sowing it broadcast, a man could increase his yield per acre from 4 quarters to 15. Few farmers were likely to believe so extravagant a promise. But Plat was on the track of a great discovery, although he and his immediate successors took the dibbing of beans as their model, and intended the seed to be deposited by hand. Others worked in the same direction. Francis Maxey (1601) described the new manner of setting corn, and invented a machine which punched holes in the ground.

On similar lines Gabriel Plattes championed the new process so eagerly that he gained the nickname of the "Corn-setter." He rivalled Sir Hugh in the extravagance of his promises. Those who followed his system and used his drill (patented 1639) were promised a hundred-fold increase in their yield. He died shirtless, and starving for want of bread, in the streets of London. But agricultural writers did not lose sight of the suggestion. Worlidge, for example, whose *Systema Agriculture* (1669) deserved, on the whole, in spite of many defects, its reputation as a standard authority, came nearer the mark. He invented a drill to make the furrow, sow the seed, and deposit the manure. The machine is figured and described in his book. But he appears never to have made or tested his implement. Professor Bradley of Cambridge, who (1727) constructed the machine from Worlidge's drawing, found that the instrument would not perform any of its three functions.

It remained for Jethro Tull, the greatest original genius in the history of English farming, to invent and perfect a practical drill. It was used for the first time on his farm at Crowmarsh, near Wallingford in Berkshire, somewhere between the years 1699 and 1709. On the drilling of corn and roots he based much of his system of clean farming. By drilling wheat and keeping the soil clean and stirred between the rows, he grew it for many years in succession without manure. Applied to turnips the process trebled their value. But, as he mournfully says, though he grew better crops, at less cost, and with greater economy of seed than his neighbours, none followed his example. It was not till drilling of corn and roots had been enthusiastically adopted in Scotland, and thence had drifted back over the English borders into the northern counties, that it gained any general hold in this country, years after Tull's death.

A Variety of Manures.—The most interesting of Sir Hugh Plat's observations are those on manures for arable and pasture land. They are contained in the second part of his *Jewell House of Art and Nature* (1594). He is so enamoured of his subject that manure presents itself to his vision as a Goddess with a Cornucopia in her hand. Basing his theories on Bernard Palissy, he argues that perpetual cropping robs the earth of her vegetative salt. Therefore the wise husbandman must continuously replace the elements of its fertility. He recommends a valuable list of manurial substances. He urges that existing practices allowed the vegetative salts of dung to evaporate by long exposure to the sun and so waste the richest properties of farmyard manures. He therefore suggests its accumulation in covered pits. He advises the use of marl, with a warning that it should be proportioned to the needs of different sorts of soil. His other manurial substances include lime, street refuse, the subsoil of ponds and "watrie bottomes," the brine of Cheshire "salt pittes," ashes, the hair of beasts, malt-dust, soap-ashes, putrified pilchards, entrails of animals or fish, and blood offal.

Fifty years later than Plat, several agricultural writers were busy on the subject of manures. Among them was a man of ingenious and inquiring mind, Gabriel Plattes, the "Corn-setter." His "*Discovery of Infinite Treasure*" was the use of the fertilising qualities of the substances carried off by water. In the soil of streams, in mud of tidal waters, and in all "coloured" water, he finds the "fatness" of the land. He suggests catch-pits to receive the water of "land-flouds," especially where they come from fertile fields or paved market-towns. He also advises ditches and sluices to admit tides to run in swiftly and pass out slowly. In both cases, the deposit makes a valuable manure which will fertilise the most barren soil. All "coloured" water should be similarly utilised on the land insteady of being allowed to run to waste.

Contemporary with Plattes, were Walter Blith (1649) and Child (1651). Both give lists of manurial substances which supplement the suggestions of Plat. Putting their recommendations together, we get a fairly complete list of the fertilisers recommended for use by agricultural writers of the 17th century. They include marl, lime, and chalk; farm-yard manure, which Child says must not be too much exposed to sun and rain; pigeon and poultry dung; swine's dung, which Fitzherbert says was harmful because it bred thistles; ashes,

both of wood and " sea-cole "; soot; malt-dust; " raggs of all sorts "; " coarse wooll, nippings and tarry pitch-markes " (Blith); horn, or shavings of horn; seaweed " of all sorts, rotted " (Child); salt dross, " much used on " meadows near Nantwich (Child); marrow-bones (Blith); blood and urine (Child); fish and fish-bones.

Child mentions the New England practice of using on the land a fresh-water fish, called the " Ale-wife, because of its great belly," very full of bones. It was, he says, caught in weirs, and sold in large quantities to farmers. Both writers suggest mud from rivers, and Child adds " owse " from marshy ditches and foreshores. Both especially recommend a soil full of small shells, taken out of the beds of certain rivers. Child, who calls it " snaggreet," says that it was much used in Surrey. Blith, who calls it " snaylecod," says that one load was worth three of horse or cow dung, that it was found in the Thames Valley and near Uxbridge, and that men gained a " gallant living " by bringing it to the surface and selling it on the river bank at from one and twopence to two and fourpence a load.

Child also recommends, as has been already noted, the practice of green manuring, and the use of lupins for the purpose. Child's *Large Letter* on agricultural improvements is full of useful suggestions. But, in the same breath, he suggests that our live-stock and the agricultural wealth of the country should be increased by the introduction of " Black Foxes, Muske-cats, Sables, Martines," and, above all, the elephant as a useful beast of draught and burden, " 15 men usually riding on his backe together." His advice has not been wholly neglected. In the Cheviots to-day there is a flourishing skunk farm.

Jethro Tull, it may be noted, objected to dung as a weed-carrier. In the writings of William Ellis we find the manures actually in use on a Hertfordshire farm in 1733-50, by an advanced farmer. Chalk was largely employed, pits being sunk to obtain the substance. Among the new ingredients are rabbit's dung and rape-dust. London refuse was freely bought: quantities of " cony-clippings, horn-shavings, rags, hoofs-hair, ashes, etc.," were bought from " Mr. Atkins of Clerkenwel." To the manures in use in the county were added, fifty years later, boiled or burned bones, sheep-trotters and malt-dust.

Before the advent of agricultural chemistry, and the establishment of the principles of plant nutrition, the science of manuring was neither studied nor understood in theory. Probably no farmer in the 16th or 17th century could have explained the precise action of the different substances which he applied. But observation of results by individuals had built up an imposing list of suggested manures, some of which had taken their place in the traditional routine of the best farmers. It is interesting to note that, though the theory was unknown, practical experiment had provided the essential elements of fertility—nitrogen, phosphoric acid and potash. All the native resources, except the coprolite deposits, were in fact utilised. It is the method of using these native materials, in their portable form, and in the discovery and use of new or imported ingredients, such as guano, phosphatic rock, the Stassfurt deposits of potash, or basic slag, that the increased command of fertilising substances mainly consists.

The effect of cattle droppings is so obvious that dung must have been employed as a fertiliser in the infancy of agriculture in every country. Its treatment might be and may be improved. But it was sheer improvidence, or stark necessity which urged farmers to waste their one natural and all-round manure by mixing it with straw, kneading it into lumps, drying it, and burning it as fuel. Standish (1611) notices the practice. It was evidently wide-spread, for Lawrence (1727) speaks of it as prevailing in Yorkshire and Lincolnshire, and considered it important enough to suggest that all leases should contain a restrictive covenant "Cowdung not to be burnt for fuel." Arthur Young (1770) found the practice in Buckingham-hire and Northamptonshire. "There cannot," he says, "be such an application of manure anywhere but among the Hottentots."

To the Romans the value of marl, lime and chalk were known, not as direct plant food, but as indirect fertilising agencies. There is some evidence that the original home of their use was Britain. But, with the invasion of the Saxons, many practices were temporarily forgotten. The use of these substances may have lingered on in farming tradition; it may have been revived by ecclesiastical agriculturists from the writings of Pliny, Varro, Columella, or Palladius; it may have been discovered afresh from their effect on the land when thrown up in digging ditches or foundations. Marl was certainly used in the 18th century in England. But the practice seems to have fallen into disuse.

Fitzherbert, who notices its cost,—it is, he says "exceeding chargeable,"—regrets that it was becoming obsolete, and Gervase Markham, writing at the close of the 16th century, infers from the age of the timber growing in marl pits that they had been abandoned for 260 or 300 years.

Barnaby Googe recommends the use of chalk in moderation; but he adds the popular saying that "grounde enriched with chalke makes a riche father and a beggarly sonne." Its use on the heavy lands of Herffordshire has been already noticed. "Mixing earths," such as chalk on heavy clay and "red clay" on sandy soils, is one of the practices to which Ellis attributes the agricultural success of the county. Large quantities of chalk were also imported into Essex from Kent, whence it was brought up the estuaries and distributed to the farms. Gypsum was another of the substances used, especially in Kent and Sussex. Towards the end of the eighteenth century, its value was more extensively recognised. When Cornish or Devonshire farmers brought sea sand from the coast on their pack-saddles, they probably did not know the exeat nature of its value, or that it mainly lies in the carbonate of lime contained in the broken shells of which it largely consists. But they anticipated the modern market gardeners of Penzance in the use of the substance; they had experienced, in some way or other, the utility of its agency.

Other substances more directly contribute to plant food. That the value of soot was soon discovered is natural enough. Thrown on some waste place, its useful properties would be observed. Whether its effect in raising the temperature of the soil, or lightening its texture, or deterring slugs and snails, or its direct fertilising qualities, commended its use to the first observer, is uncertain. It was employed, for one or other of these reasons, in the Middle Ages.

More difficult to explain is the discovery of the nitrogenous value of such substances as "cony-clippings," hair, shavings of horn, or woollen rags. Their effect is so slow that it might be imagined that it would escape detection. Yet they appear in the 17th century lists of manures, and, as has been noticed, were bought by Hertfordshire farmers from London salesmen in the first half of the eighteenth century.

Seaweed was extensively used in counties where it was accessible, and in South Wales the practice is especially noticed. Another nitrogenous manure available in maritime counties was fish-waste, such as the "putrified pilchards" suggested by Sir

Hugh Plat. Memory of smells is peculiarly tenacious. Those who have once experienced the stench of sprats on fields in the Isle of Wight, sixty years ago, have not forgotten it. For more inland counties there were slaughter-house refuse and dried blood. The valuable properties of malt-dust were, as the lists show, early appreciated and more generally available.

Seventeenth century writers provided farmers with a considerable choice of nitrogenous manures. They were less rich in their suggestions of substances containing either phosphoric acid or potash. Possibly "snaggreet," the shelly deposit which is mentioned by Child and Blith, may have been mainly valuable as a phosphatic manure. Some phosphates would also be contained in Cornish sea-sand. Otherwise bones were the only available substance. Traditionally their value was observed by a Yorkshire master of foxhounds on the grass surrounding the kennels. At first they seem to have been roughly broken by hand labour on the farm. But by the middle of the 18th century it had become a trade to grind bones for agricultural use, and the value of boiling or steaming them was also recognised. Their use, as has been noted, was recommended by Blith in 1653, and similar advice was given by subsequent writers in the 17th century. The discovery of coprolites by Professor Henslaw (1845) in Cambridgeshire is comparatively recent.

For potash, farmers depended entirely on ashes. Their use is recommended in all the early lists of manurial substances. Some evidence exists to show that an industry was established for their production and supply. Thus William Ellis, the Hertfordshire farmer, speaks of a potash kiln in Buckinghamshire. It is also on record that, in the 18th century, Kentish hop-growers organised a system of collecting the wood-ashes of neighbouring cottagers. Essential though potash is, it is especially valuable in its effect on some of the crops which were the latest comers in English agriculture, such as mangolds and potatoes. The field cultivation of potatoes, recommended by John Forster (1664), but not practised outside Lancashire on any extended scale till the last century, has owed much of its later development to the discovery of the Stassfurt deposits.

Live Stock.—The illustrations given from agricultural writers of the 16th and 17th centuries, show that many of the triumphs of modern farming had been anticipated. The materials were already collected for the great agricultural advance which took place in the last forty years of the reign of George III. It may be added that, as early as 1645, the neces-

sity of securing to tenants the value of their unexhausted improvements had been pleaded. Where so much had been anticipated, one omission on the part of the "Rustick Authours" is striking. There is scarcely any suggestion for the improvement of live stock. On this side of their subject, writers are meagre and inadequate. None of them discuss the subject with any completeness, or with much regard for varieties of breed or for the different purposes for which animals are bred. Worlidge's *Systema Agriculturæ* (1669), for instance, passed rapidly through five editions. But the subject "of Beasts" is dismissed in 3 pages, while 106 pages out of the total number of 217, are devoted to trees, orchards, gardening, bees and silkworms. The neglect of stock-breeding and stock-rearing was not unnatural, so long as little fresh meat was eaten, and so long as winter keep was short, and the stock herded promiscuously on commons or in common folds. But as the first half of the 18th century drew to a close, the practical obstacles were to some extent removed. The market for fresh butcher's meat improved. Farms in separate occupation multiplied. Roots and temporary grasses were creeping into the rotations. When once the improvement in stock-breeding began, it spread with the utmost rapidity. Perhaps farmers adopted the principles laid down by Robert Bakewell (b. 1725; d. 1795) with the greater enthusiasm, because they were the first improvements initiated by one of themselves. The movement owed nothing to book-farmers. It met the needs of a growing demand and afforded an outlet for the natural bent of the genius of English agriculturists.

Drainage.—Drainage was the only other essential to farming progress which still lagged behind. It had been sensibly discussed by Walter Blith in 1649 and 1652. But the Cromwellian Captain and Puritan, who brings Scripture to enforce his argument, commanded none of the modern appliances. Otherwise, the inauguration of the movement for improved live stock completed the necessary preparations for a great agricultural advance.

In the progress of the 19th century Science played the most conspicuous part. Its continued aid offers the only reasonable hope of increased prosperity in the future. Its advice has been purged of the faults which originally brought book-farming into disrepute. But the history of agricultural literature in the times of the Tudors or the Stewarts is at once an exhortation and a warning to 20th century farmers to keep their eyes open.

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SCIENCE AND THE FARMER.

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THE makers of new science have often been reproached for thinking more of knowledge for its own sake than of "the relief of man's estate." That this reproach is in general unjust may be proved by an appeal to history, for it is quite certain that most of the more striking inventions that have profoundly changed the life of man have sprung from very abstract researches. First light, and then fruits, as Bacon said. The search for *Principles* always pays. But there is another answer to the unjust reproach, and that is to point to the ever-increasing body of new knowledge which has direct practical applicability and yet is left unutilised. A perusal of the stimulating Report which Mr. V. E. Wilkins has recently drawn up for the Ministry of Agriculture* shows what a wealth of useful knowledge there is which is not in general circulation: for here we find scores of discoveries of obvious practical value to the farmer which are not being applied except by a few. This is partly because we are in many departments of life in process of transition from the empirical to the scientific; it has not become natural to the farmer to seek expert advice except from the veterinarian. It is all too characteristic of the Briton to stick to methods that yield *tolerable* results, instead of pressing on to new-fashioned ways which promise something much better. Another reason for this Gallio-like indifference is that in days past valuable research was often, as it were, tied up in a napkin of technicality and hidden in the ground of a blue book. But we have changed all that. The record of recent scientific achievement which Mr. Wilkins has written is as clear as crystal and as interesting as a novel. It is a hand which science stretches out and it is for the farmer to grip it. When he does so he will find his reward.

The philosophy of the subject is plain. The nation's higher progress (in the life that is more than meat) depends on improved health and increased wealth. But more wealth means greater command of the resources of nature, and the chief of these is food. The farmer is the fundamental food-producer, and thus progress largely depends on him. But British Agriculture is

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passing through hard times, and therefore Science steps in with suggestions which will enable the farmer to get better results with less expenditure of time and energy. We grant at once that other remediary measures are necessary, but here is an obvious one—how to be wealthy by being wise! Everyone wishes to succeed, to get some way on, to have production speeded up; and the Ministry of Agriculture meets this desire with the suggestion—"Try some of our patent scientific levers." It is a fair offer and one that may be trusted. Even if there be a difference between what can be done in the station at Rothamsted and what can be done on a farm at Rothiemurchus, it is for the farmer to meet the scientist frankly and show where the hitch is. Empirical lore is often marvellous, but it will lose nothing by joining hands with scientific research. Indeed, it is sure to gain.

Let us take a few instances of the new knowledge which promises new power. The soil is fundamental, of course, but the days of soil fatalism are long since past. To Dr. Russell and his school we owe a knowledge of the ways of making the soil young again when it grows exhausted, and of making it whole when it turns sick. For the soil is living to a degree that Liebig never suspected. Farmyard manure is becoming scarcer—thanks to motor transport—but there is plenty of straw. So the bacteriologist steps in and harnesses two kinds of bacteria to the task of rotting the straw. How well they do it may be inferred from the fact that an experimental plant has been devised capable, it is believed, of turning out 2,000 tons of straw manure per annum, at a cost probably under £500. This is just one example out of many; we might refer to experiments on green manure, on making crumbly soil, and on curing acidity. We would rather emphasise the stimulating idea of scientific control. Tilth is something of a mystery; analyse it—discover what it actually means, physically and chemically—and a new day dawns: it can be controlled. The new work has also brought into prominence, as we said, a new idea:—"The soil is no longer looked upon as an inert mass of mineral particles: it is a great living complex, teeming with countless millions of living things each struggling for existence, and each having some influence on those complicated chemical changes on which the growth of all plants depends, and which in the course of ages have turned a stratum of bare rock into something approaching a vast chemical laboratory."

Just as the synthetic chemist has been like a conjuror shuffling the cards of Carbon, Hydrogen, Oxygen, Nitrogen and so forth,

and producing the most extraordinary "hands" or novel carbon-compounds; so the breeder, since Mendel taught him the trick, has been able to produce new combinations which have made the world richer. Metaphorically he grafts on new characters of value and prunes off old characters that are detrimental, and so we get Yeoman wheat from Professor Biffen of Cambridge, Plumage Archer barley from Mr. Beaven of Warminster, and Blue Cone wheat from Professor Percival of Reading. We may almost speak of the creative biologist, though he is really not more than the architect of the materials which are provided by Nature. "A wheat giving a slightly increased yield, or better able to withstand the weather conditions of this country, puts money in the pockets of the farmer, and by increasing home production and thereby lessening our dependence on the foreigner, is a national asset." The story of plant breeding is a romance, but it is also a recipe-book for getting rich. Take one of the least sensational inquiries, the Welsh study of the kinds of oats suited for different altitudes. There are varieties in common use among the farmers, but these turn out to be mixtures of different strains, and therefore apt to be disappointing. What the Aberystwyth Station is doing is separating out these strains and selecting the best, which will then form the material for further improvement by breeding. When this is done each farm will be able to secure the seed best suited to the local conditions. The same thing is being done with the more intricate problem of pasture grasses.

With a better understanding of the soil is associated a better understanding of the living plant, and botany comes to the farm, inquiring into the factors influencing crop yield, the meaning of the mysterious quality of immunity to fungoid disease, the possibility of stimulating cereals with electricity, and so on down to details like the cause and cure of the "mealiness" which develops in apples and pears that have been stored too long. It is safe to predict that in years to come the farmer and the physiological botanist will be close friends, with much to say to one another. There is the plant-pathologist too, with his advice on "finger-and-toe," potato "scab," "bunt" in wheat, and all the terrible list of plant-diseases, including, of course, those like "big bud" which are due to animals. Progress towards eradication and prevention seems to be very slow; but the life-histories of many pests are being unravelled and control is bound to follow. What has been achieved (we do not think the word too strong) of recent years is outlined in Mr. Wilkins' report; we wish to emphasise the fact

(commonplace, if you like, yet not vividly recognised) that *the days of submission to disease are over.* The Research Institute on Plant Pathology at Rothamsted is, we understand, able and willing to act like a medical advisory centre diagnosing disease, and suggesting such remedies as the state of science can conscientiously recommend. In all this there is great gain. There is a socialising of science (perhaps more advanced in agriculture than in any other field), and there is a transition from empirical lore, of which we speak appreciatively, to scientific control.

This country is deservedly famous for its cattle and sheep, but there is no reason to believe that the output of meat is anything like what it might be. Moreover, the bill for imported feeding stuffs is far too heavy, amounting in 1919 to nearly sixty millions sterling. Hence the importance of the Animal Nutrition Institute at Cambridge and the Rowett Research Institute at Aberdeen. Nothing but patient experiment can determine what protein foods, for instance, are most profitable, and what proportions are best. An excess may be positively injurious as well as wasteful. Only in well-equipped institutes can security be reached in regard to such a subtle thing as digestibility; and the energy requirements of an animal can only be guessed at without the use of a calorimeter. We have personal experience to help us in regard to our own energy-requirements and capacities for digestion, yet we are continually making mistakes; how much more likely are we to err in regard to stock into whose feelings we cannot enter!

Another question of profound interest concerns the minute "accessory food substances" or vitamins which are known to play an essential part in the health of man and beast. The subject is still very young, but it seems that cases of slow growth, digestive troubles, and lack of vigour are sometimes due to monotony and artificiality of diet. Thus the Cambridge workers showed that rye alone was an entirely unsatisfactory food for young pigs, but was thoroughly wholesome when supplemented by a handful of grass per day. Similarly, the Aberdeen workers found that the so-called "rickets" of pigs depends not so much on a deficiency of vitamins, as on a lack of mineral matter. All these questions are intricate; they demand scientific precision; but they all mean money, and even on this ground only they are more than welcome.

There is, however, reproduction as well as nutrition to be considered in enlightened animal husbandry. The see-saw of life is between the two. Thus there are important researches in progress which are inquiring into the occurrence of "heat"

in young heifers, into the factors controlling the formation of milk, and into the wastage of reproductive activity that is apt to occur in such domesticated animals as pigs, sheep, and rabbits.

The Mendelian experimenters, in Cambridge in particular, continue to give most of their attention to such types as rabbits and poultry, for these are relatively inexpensive and breed rapidly. When secure conclusions have been reached on the phenomena of heredity in these cheaper types, they will be applied to cattle and sheep. There is, of course, much knowledge already available, and it is rapidly increasing. If the farmer wishes to know how to prevent the occasional recurrence of red calves in his highly-pedigreed Aberdeen-Angus breed, he has only to apply to the Mendelian expert, or to think out Mendelism for himself. Or if the poultry-breeder wishes to tell *at hatching* the sex of his chicks, there is no difficulty in doing this when silver hens are mated with gold cocks, and in several other cases. There is money here too, for the breeder can kill off his unwanted cockerels at hatching, and rear double the number of pullets with the same plant. It is impossible to conceive of farmers not being interested in the clearly-expressed indications which Mr. Wilkins gives of the breeding-researches in progress in centres like Cambridge and Edinburgh, *e.g.*, the endeavour to improve the quality of Blackface wool, or to sift out coloured hairs from the fleece.

With healthy stock there is always something doing, but sickness blots out the sun. So we turn with expectation to the section of "Agricultural Research and the Farmer," which deals with animal diseases. There we find, as we knew we should, that science continues to tackle the hydra-headed monster which seems never to accept defeat. Thus the Royal Veterinary College in London has been experimenting with a vaccine treatment of the "joint-ill" which carries off many young foals; with a serum treatment of contagious abortion in mares; and with contagious inflammation of the udder in cows. Needless to say, solutions are not picked up like blackberries, but the point is that the days of folded hands are quite over, and that the conquest of disease goes on.

Just as the Aberdeen investigators of "Isle of Wight" disease in hive-bees recently had their reward in the discovery of a trachea-blocking mite, so in regard to other parasitic diseases of other and larger domesticated animals there is progress to report. Thus there has been a successful clearing up of the life-

history of the round-worm which causes scouring in sheep and of another which lives in the intestine of fowls. It is very much to be desired that something definite should be discovered in regard to the lamb tapeworm, which appears so soon after birth. Its life-history seems to be peculiarly difficult, and here is a case where co-operation between sheep-farmer and parasitologist might yield results of national value. We cannot afford to leave any important parasite in the dark.

We have not nearly "sampled" the whole of "Agricultural Research and the Farmer"; we have not touched, for instance, on the chapters dealing with fruit-growing and with dairying. We hope we have said enough in our appreciation to excite some interest and expectancy. Frankly we must confess to some enthusiasm over this record of scientific achievement, for we had not quite realised the cumulative effect of a multitude of new researches all converging on "the relief of man's estate," as Bacon phrased it. The biological control of life is here in progress before our eyes; and we submit that it should make the eyes of the farmer glad.

Here is a treasury of new knowledge and the Open Sesame is half-a-crown to His Majesty's Stationery Office. We have not had more interesting or more cheerful reading for many a day than this story "Agricultural Research and the Farmer." It was, if an outsider may say so, a happy thought on the part of the Minister of Agriculture to devise such a record, and it has been accomplished by Mr. Wilkins with masterly workmanship. We should like to suggest several ways in which its value might be brought home to the farmer.

(1) We are not fond of the saying "seeing is believing," but perhaps the reality of the new researches would be more widely appreciated if there were more opportunities for visiting the Experimental Stations to see things actually happening.

(2) Perhaps more might be made of the Shows and Conferences, where results could be exhibited so that he who runs might read.

(3) No one would wish to interrupt a maker of new knowledge, but there is no doubt that an address from one of the discoverers about his own discoveries is very highly appreciated and never fails of far-reaching effect. It might not be altogether detrimental to the discoverers themselves if such educational excursions were less rare. We know, of course, the splendid expository work of the Universities, Colleges, Stations, and County Organisers, but there is incalculable value in personal contact

with the men who are actually making the new science. The Lieutenant is often admirable, but the farmers wish to meet the General. It is in such meetings that some enthusiasm is created, which may lead, for instance, to symposia in which the farmers can thrash out things for themselves, perhaps with a Professor of Agriculture as a referee.

It is impossible to think of a winter-afternoon exercise more profitable intellectually and pecuniarily than going through a book like "Agricultural Research and the Farmer." And it adds to its own merits by giving a guide to detailed literature.

It often looks as if there were some serious flaw in the connections which should bind the scientific expert and the farmer in co-operation. Perhaps this is in part due to the superiority of the pioneer scientists who queered the pitch by finding no place for the empirics, who retaliated by having no use for them! The day for this is past. In many cases the empirics were and are quite marvellous, sometimes reminding one of physicians born with a flair for diagnosis. All the surviving lore of the old farmers is valuable, as long as it is not superstitious. Yet it requires to be rationalised and illumined, and the long and short of it is that *scientists and farmers cannot afford not to join hands*. In active co-operation in the quest for new knowledge mistrust will disappear and mutual appreciation will grow.

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THE SCHOOL OF AGRICULTURE OF THE UNIVERSITY OF CAMBRIDGE.

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Agriculture has been a subject of academic study in the University of Cambridge for less than 30 years. Nevertheless it is by no means an easy task to describe precisely the earlier stages of its development. Like most of the newer departments of the University, the School of Agriculture in its present form has grown up gradually from small beginnings.

Informal Beginning.—A windfall to the Exchequer, the foresight of a Minister of Agriculture, and the persistence of a small committee of enthusiastic members of the University and of the neighbouring County Councils assisted at its birth. A hard-working staff, backed by the prestige of the University, and

nourished by private benefactions and by increasing grants from County Councils, from the Ministry of Agriculture, and from the Development Commission, have succeeded in establishing it in its present position.

The writer, who has been connected with the School for 28 years, welcomes this opportunity of setting out in the following paper his impressions of the development of the School in the past and his idea of the part it may hope to play in the future.

When he made his budget in the spring of 1889 the then Chancellor of the Exchequer expected a licensing Bill to pass in the next session of Parliament. This Bill included a provision for extinguishing certain licences, and in order to provide a fund for compensating the holders of these licences the Chancellor put an increased duty on spirits. The Bill being subsequently defeated, the Chancellor was left with an unexpected surplus which was handed over to the newly-created County Councils to be used for Technical Instruction.

Many of the County Councils decided to spend part of their Technical Instruction grant, or "whisky money," as it was commonly called, on Agricultural Education, and at once a great demand arose for Agricultural Teachers, a demand which the existing agricultural teaching institutions were unable completely to supply.

The President of the Board of Agriculture at that time Mr. Henry Chaplin, now Viscount Chaplin, foreseeing that a deficiency of trained agricultural teachers would jeopardise the success of the campaign of agricultural education which his Board desired to foster, wrote to the Chancellor of the University, the late Duke of Devonshire, a letter dated 25th July, 1890. This letter contained what the writer believes to have been the first suggestion that a Department of Agriculture should be founded in the University of Cambridge. It was communicated by the Chancellor to the University, who at once appointed a syndicate to consider the suggestion and to report on its possibilities

After nearly two years of discussion the syndicate presented to the University its report, which recommended the creation of a Department of Agriculture on a scale which the University were unable to accept for lack of adequate funds

The Syndicate, however, did not accept defeat, but set to work to prepare a less ambitious scheme, of which more anon. Meantime one of the members of the Syndicate, Professor Liveing, head of the Chemical Department, had in the long vacation of 1891, organised under the late Mr. Henry Robinson, of Downing

College, who had spent some time at the Royal Agricultural College, Cirencester, a class for senior students who proposed to take up agricultural teaching. This class, which to the best of the writer's belief was the first agricultural class held in Cambridge, was attended among others by Professor John Percival, of Reading, Mr. R. H. Adie, now Secretary of the School of Agriculture, Mr. Cecil Warburton, Zoologist to the Royal Agricultural Society, and the writer. The instruction was not exactly systematic, but much valuable information was obtained by visits to Rothamsted, Woburn, Sawbridgeworth and other centres of agricultural interest.

At the same time, Professor Liveing, and Professor Hughes, head of the Geological Department, had begun negotiations with representatives of a number of neighbouring County Councils, among whom were Mr. Albert Pell of Northamptonshire, Mr. Arthur Sperling of Cambridgeshire and Mr. Howard Coote of Huntingdonshire. These gentlemen constituted an informal Committee, the Cambridge and Counties Agricultural Education Committee, which was assisted in its deliberations by the late Mr. A. E. Brooke-Hunt, Educational Inspector of the Board of Agriculture. With the aid of a small capital grant from the Cambridge County Council for equipment, and small annual grants from that County Council, from other neighbouring counties, and from the Board of Agriculture, this Committee began in January, 1893, to give an organised course of instruction in agricultural science. Professor Liveing was Secretary and Treasurer of the Committee, Mr. Albert Pell, Chairman, and Mr. Henry Robinson the only full time officer. Headquarters were in rooms lent by Professor Liveing in the basement of the chemical laboratory, where Mr. Robinson gave lectures and practical classes in agricultural chemistry. Professor Hughes gave a special course of lectures on agricultural geology, illustrated by frequent field excursions. Agricultural botany was taught by Mr. I. H. Burkill, of Caius College, now Director of the Botanic Gardens at Singapore. There were seven students, all scholars of one or other of the contributing County Councils. Only two of them were members of the University. The Committee maintained a room in St. Mary's Passage as a reading room and library. Meantime, the second report of the Syndicate, recommending the institution of a Diploma in Agriculture, was accepted by the University in November, 1893, and the first Diploma was awarded in July, 1894, on the results of examinations held in that month.

This was the state of things when the writer returned to Cambridge as successor to Mr. Henry Robinson in January, 1894, his duties being to act as Secretary to the Committee, to teach agricultural chemistry, and to supervise three manurial experiment stations, which had been established by neighbouring County Councils, namely, Higham and Lavenham in West Suffolk and Bramford in East Suffolk. The latter was notable as the only station in the writer's experience where phosphatic manuring failed to produce any appreciable effect even on the turnip crop.

Financial Difficulties.—For some time financial support from the Counties was so fitful that the Committee repeatedly found itself in financial straits, and on one occasion in 1897, Professor Liveing, the Treasurer, called a special meeting at his house at which the winding up of the Committee's venture was seriously discussed. In the course of the next year, however, largely through the instrumentality of the Cambridge County Council and the personal efforts of the late Mr. Austin Keen, its Organising Secretary for Education, county contributions were put on a more permanent footing, the County Councils of Cambridge and 9 other neighbouring counties agreeing to contribute annually a definite percentage of their Technical Education grant, and to appoint two representatives on the Committee. The Committee agreed to accept scholars from these counties on favourable terms, to supervise local experiment stations, to provide summer courses for elementary teachers, and to supply local lectures in the counties, the last two items in collaboration with the Local Lectures Syndicate of the University. This arrangement provided an annual County Council subvention of about £750, which through the good offices of the late Mr. A. E. Brooke-Hunt, the very sympathetic inspector of the Board of Agriculture, was suppplemented by an increased Government grant. This proved to be the turning point of the development of agricultural education in Cambridge—the record from that time is one of continual development.

In 1896 the University had received its first benefaction for agriculture in the form of the endowment for 21 years of a Lectureship in the History and Economics of Agriculture by the late Sir Walter Gilbey. Its increased permanent income also enabled the Committee to appoint in 1897 an experimental assistant to take charge of the supervision of local experimental work.

During the years 1896 to 1899, progress was steady. The number of students rose to 20. The increased staff found time

for a certain amount of research both in the laboratory and in the field. The number of local experiment stations in 1899 had risen to over 50, scattered widely throughout the contributing counties, and plant breeding experiments had been begun in a small garden behind the Cambridge Technical Institute in East Road lent by the Joint Education Committees of the County and Borough of Cambridge.

Formal Foundation.—It was at this stage that the University took over the control of agricultural education from the Cambridge and Counties Agricultural Education Committee. The events which brought about this important step are of some interest. In 1898, Sir Walter Gilbey offered to the University a second benefaction, a capital sum sufficient to maintain for 10 years a lectureship in some branch of technical agriculture or agricultural science. The fact that this offer was accompanied by the condition that the University should recognise an examination in agriculture or agricultural science as an avenue to a degree caused somewhat prolonged negotiations. Whilst these negotiations were proceeding the University received an offer of a third benefaction—from the Worshipful Company of Drapers—of the endowment for 10 years of a Professorship of Agriculture, on condition that the University would found and maintain a Department of Agriculture and would recognise agriculture or agricultural science as a subject of study for a degree.

Both these generous offers were accepted in the early months of 1899 and the University took over the work of the Cambridge and Counties Committee as a going concern, the financial arrangements being greatly facilitated by the promise of an increased annual grant from the Board of Agriculture. A Board of Agricultural Studies was created to conduct the teaching and examining, and both the Cambridge and Counties Committee and the Agricultural Examinations Syndicate were dissolved. The diploma examinations were remodelled and the University recognised the first examination as a special examination for the ordinary B.A. degree.

The Drapers' Professorship of Agriculture.—In the autumn of 1899 Professor Somerville was elected as the first Professor of Agriculture on the Drapers' foundation, and the newly constituted Department of Agriculture began work in October, 1899, with a full time staff consisting of Dr. Somerville as Professor of Agriculture, the writer as Lecturer in Agricultural Chemistry and Secretary, and Mr. R. H. Biffen as Lecturer in Agricultural Botany. This staff was housed in four

small rooms in the basement of the University Chemical Laboratory lent by Professor Liveing, and in a small room in the Botany School lent by Professor Marshall Ward.

Within a year a farm of 140 acres was added to the equipment, Burgoyne's Farm, Impington, 5 miles from Cambridge, being leased to the University rent free for 10 years by the late Mr. W. A. Macfarlane Grieve of Clare College. The farming capital of £1,500 was collected by public subscription.

Under Professor Somerville this farm was stocked and equipped, local experimental work was extended by the establishment of several experiment stations on a more permanent and ambitious scale, notably the "manuring for mutton" stations at Hatley, Cransley, and Trowse, and the "schemes of manuring" stations at Saxmundham, Hatley, Great Thurlow, and Thriplow. Laboratory research was also actively prosecuted, chiefly in the direction of studying the composition of various crops. Biffen's plant breeding work, endowed with a new weapon by the rediscovery of Mendel's laws of heredity, made steady progress. The teaching was reorganised by the inclusion of systematic instruction on the practical side of agriculture, and the number of students slowly but steadily increased.

In 1902, Professor Somerville left Cambridge in order to fill the important position of Assistant Secretary in charge of the Intelligence Division of the Board of Agriculture. During his short stay his personal gifts and the success of his practical experiments had made an important contribution towards the establishment of the new department as one of the scientific departments of the University. He was succeeded by Professor (now Sir Thomas) Middleton, who, like his predecessor, left the chair of agriculture at Armstrong College, Newcastle-on-Tyne, to come to Cambridge.

Professor Middleton extended the experimental work inaugurated by Professor Somerville by including in the farm programme a very comprehensive series of variety trials of oats, potatoes, mangolds and other farm crops, and in collaboration with the writer, at that time Reader in Agricultural Chemistry, carried out an important series of feeding trials at several centres to test the nutritive value of different varieties of mangolds. Research work on the composition of crops was actively prosecuted by the writer and his assistant, Mr. R. A. Berry, now Professor of Agricultural Chemistry at Glasgow, and by Mr. Biffen on plant breeding. The steady increase in the number of

students was maintained, and a number of men entered for the final Diploma course after having taken an honours degree in Natural Science. Such men readily obtained good positions in India and the Colonies, and Professor Middleton's Indian experience was an important factor in encouraging a class of students of this type.

As the number of students increased it became evident that the department was outgrowing its temporary home in the chemical laboratory, and the need of a permanent agricultural laboratory became pressing. The first step was taken at the Royal Agricultural Society's show at Derby in 1906 when His Majesty King Edward VII, who was staying with the late Duke of Devonshire, Chancellor of the University, visited the show and expressed great interest in the Department's exhibit of new varieties of cereals in the Education building. The Duke soon afterwards consented to act as chairman of a special committee of the Cambridge University Association with the object of collecting £20,000 to build an agricultural laboratory, the University having promised to provide a site adjoining the other scientific laboratories and museums. The Worshipful Company of Drapers, whose munificence had already created the Professorship of Agriculture, headed the subscription list with the offer of £5,000 on condition that an equal sum should be promised immediately. This condition was fulfilled at the first meeting called in London by the Committee. Very soon afterwards, the Duke of Devonshire, who had initiated the scheme, died. His place as chairman was taken by the present Duke, to whose energy the ultimate success of the scheme was due.

Meantime Professor Middleton, like his predecessor in the Chair of Agriculture, accepted an Assistant Secretaryship at the Board of Agriculture, which made it necessary for him to leave Cambridge in May, 1907. He was succeeded by the writer, whose appointment necessitated a considerable reorganisation of the Department. Professor Middleton had taken charge of the teaching of Agriculture and the direction of the farm. The new Professor continued his teaching of agricultural chemistry, and the agricultural teaching and the farm were put in the hands of Mr. K. J. J. Mackenzie, who had been Vice-Principal of the South Eastern Agricultural College.

A few months later, the Drapers' Company gave further evidence of their great generosity by increasing their annual grant and renewing it for a second period of 10 years to 1919. This enabled the University to create a second agricultural professor-

ship, and Mr. R. H. Biffen, whose distinguished work on the improvement of cereals had already begun to achieve practical success, was elected Professor of Agricultural Botany in the spring of 1908.

The New School of Agriculture.—Meantime the Duke of Devonshire's committee had continued their efforts, and in the autumn of 1909 the University Association was able to hand over to the University the sum of £20,000. The University assigned a site adjoining the Botany School and the Sedgwick Museum of Geology, and appointed a syndicate to supervise the erection of the building. The preparation of plans was entrusted to Mr. Arnold Mitchell, F.R.I.B.A., and the contract for the erection of the building was given to Mr. William Sindall of Cambridge. The School of Agriculture was formally opened by the Duke of Devonshire on 26th April, 1910, though the staff and 40 students had been in occupation since January. The building has proved satisfactory in every way and reflects great credit on both the architect and the contractor. Its total cost was about £17,500. The balance of about £2,500 was invested by the University, the income being applied to the payment of rates and maintenance.

(To be concluded.)

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FARM BUILDINGS FOR SMALL HOLDINGS:

VARIATIONS FROM THE NORMAL.

MAJOR H. P. G. MAULE, D.S.O., M.C., F.R.I.B.A.

IN a previous article* a description and illustrations were given of a type of building with a single span roof for a 50-acre mixed holding, and it was suggested that if this type proves successful in practice further development might take place on similar lines. One of the objects of these articles is to draw attention to any new methods of planning and construction or any variant of an old method in order to elicit opinions on their merits or demerits, with a view to future improvement and evolution.

* Farm Buildings for Small Holdings: A West Riding Improvement, this *Journal*, May, 1922, p. 113.

There can be little doubt that reform is needed in the planning and detail of new buildings, and perhaps more particularly in the reconditioning and adaptation of existing ones. Moreover, the present economic situation is such that any new building or adaptation work dictated by the necessity for improved returns must be carried out with the strictest attention to capital outlay, as well as to the cost of annual maintenance. It is therefore of real importance in the interests of practical farming that full publicity should be given to any new idea or variations from the normal, in order to separate the wheat from the chaff and to arrive at any definite facts which will assist both farmers and architects to solve the building problems of the future.

This article deals with two other variants from the main normal types of 30- to 50-acre holding buildings referred to in the previous article and has a twofold object: (*a*) to compare the West Riding Single Span Scheme with buildings now illustrated, and (*b*) to suggest that the types discussed here may be a valuable guide in certain kinds of adaptation work.

Figs. 1 and 2 illustrate buildings on a 20-acre mixed holding, erected by the North Riding County Council, and show all the various departments of the farm grouped under a single roof.

The main difference from the West Riding type is (1) that no real covered stock-yard is included under the roof, only a cattle shed of very small dimensions, which, however, might presumably abut upon an open yard if desired; (2) that the centre of the upper part of the building is constructed as a loft giving ample floor space for the storage of hay, grain, cake, etc., and with access provided from the mixing floor below. In appearance the building is very similar to a south country straw barn, and it is this construction which suggests that the latter might in many cases be converted to a complete range of buildings at comparatively small cost and with profitable results.

The root store and mixing floor is placed centrally on the north side with exceptionally easy internal access to all parts of the building, and for direct and simple labour-saving planning the scheme in this respect is difficult to improve. The cow byre is placed centrally to the south with a feeding passage between it and the mixing floor, and with direct external access. There is also direct external access to both stable and loose box.

In comparison with the West Riding Scheme it must be noted that the acreage of the latter holding is considerably greater, and that the type of construction is fundamentally unlike. The

provision of the loft immediately above the greater part of the area devoted to stock contrasts with the open roof of the West Riding Scheme, and it is the effect of these different treatments which it is essential to know. If the results are satisfactory it is not too much to say that a valuable contribution has been made both to the planning of new buildings and the adaptation of old ones. Here again what is now needed is some record of the actual working results. If it is found in practice that the health of the stock does not suffer from over concentration in the effort to obtain a labour-saving plan, it is obvious that further development on these lines might well be found to be suitable to larger buildings for an increased acreage.

It is sometimes difficult to know how to make the best use of old timber-framed straw barns, which are often in an excellent state of structural repair, or possess the probability of a long and useful life if adequately repaired or re-roofed. In general dimensions and appearance many are very similar to the North Riding Scheme and could be easily and economically sub-divided upon the lines indicated.

Figs. 3 and 4 show the equipment of a 30-acre holding on the Stockton Grange Estate of the Durham County Council and show a very simple arrangement as far as plan is concerned, but a very different method of roof construction.

In convenience of ground plan there is little to choose between the two schemes, the transposition of the stable and loose box being comparatively unimportant and probably governed by the nature of the site and approaches. The chief difference in plan is the position of the granary, here placed solely over the cart shed by raising the roof at this point (*see* Fig. 4).

The roof has been constructed in the form of two parallel small single spans with a long gutter between carried over the central dividing wall, the granary as already stated being roofed at a higher level over the cart shed. It can, the writer thinks, be shown that a single span roof of modern construction could be built more economically in initial outlay than by the method selected and without the expenditure in annual upkeep of the long gutter between roofs, always a source of trouble and expense, and particularly so in the neighbourhood of stack-yards. It may be that a single span roof was discarded on the score of exposed situation or because it was considered undesirable to put any floor over the heads of the live stock. If the latter is the true explanation it is again a point which can only be determined by careful observation and continued practice, and the architect must be guided by the practical farmer.

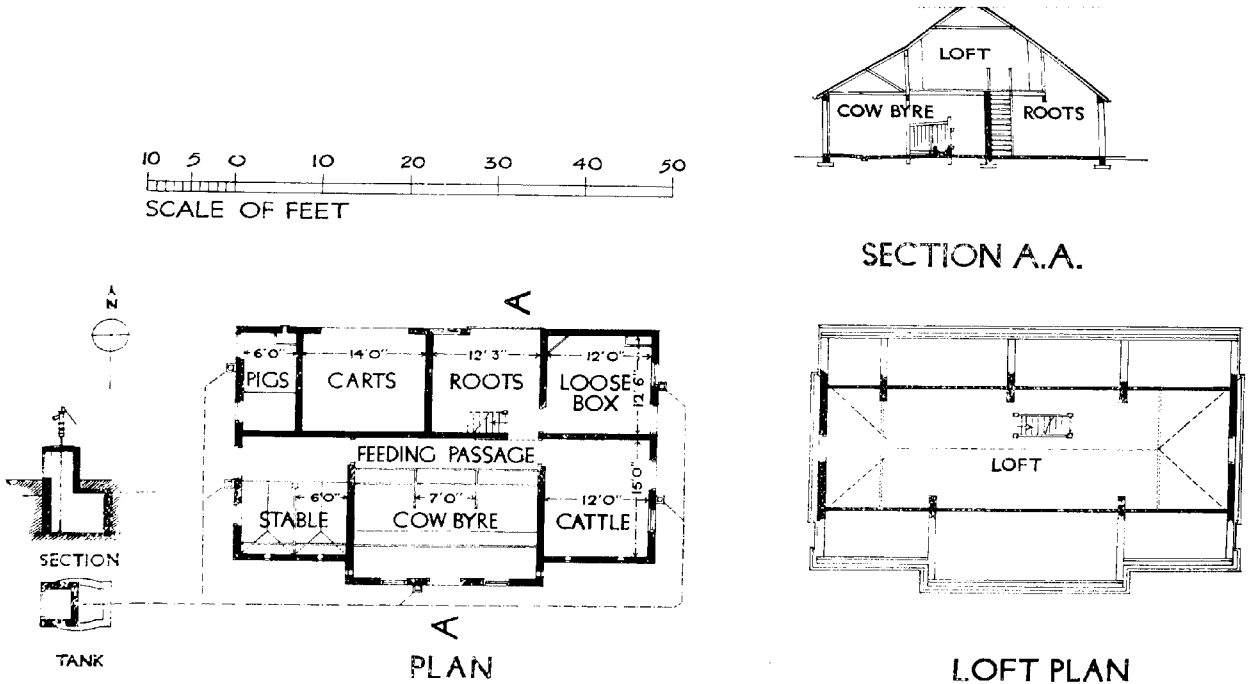

FIG. 1.—North Riding County Council. 30-acre Holding Farm Building.

Fig. 2.—North Riding County Council.—30-acre Holding: Farm Buildings.

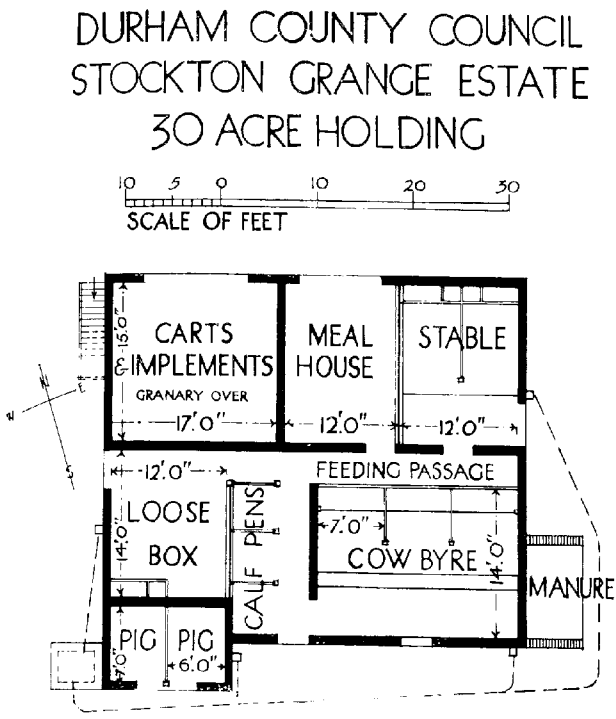

FIG. 3.—Plan of Farm Buildings.

FIG. 1.—General view of Farm Buildings from the South.

If a covered yard is of such great importance both for increasing the head of stock and for the production of the best grade of manure as we are inclined to think, then it would appear that the West Riding type should give the best results on both counts, particularly in an exposed situation where increased shelter and warmth are imperative. If, also, it can be shown that the provision of a loft over stock is not detrimental, provided adequate ventilation and cubic space are given, it would appear that the North Riding Scheme, with the single roof and large loft is the more advantageous of the two described in this article for smaller holdings where the West Riding type would be too costly. There is good reason to think that in the matter of cost, by careful planning and new methods of construction the single roof type might be the cheaper method and can be so constructed that there need be no fear on the score of increased annual upkeep due to exposed climatic conditions. Possibly some compromise between the North and West Riding types could be evolved giving a small covered yard as well as the loft space.

Although these two examples of concentrated planning are covered by different types of roof they may for practical purposes be regarded as the offspring of the same desire, viz. :—to reduce the labour in tending stock to the minimum. As such plans are widely different from the majority of small holding buildings erected during the past few years, and are approximate in principle to modern American and Danish methods, they may be considered of more than passing interest. This type of plan, carefully worked out, must be more economical than the open courtyard type with its increased amount of external walling and angles, gutters, down pipes, drains and larger area of ground covered, and it does undoubtedly fulfil the great principle of economy of labour in the concentration, preparation, and distribution of fodder. For these reasons these Yorkshire and Durham types are worth careful consideration, not only with regard to future small holding equipment, but also inasmuch as they represent in embryo principles which, if found successful in practice, might be extended to much larger acreages.

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PHOSPHATIC FERTILISERS.

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PHOSPHATES serve at least five purposes in the soil:—

1. They cause an earlier development of the young plant than would otherwise occur;

2. They bring about a considerable development of fibrous roots;

3. They counteract the rankness of growth which is liable to occur on land richly supplied with nitrogen compounds;

4. They hasten ripening and improve the quality of grain;

5. They increase the feeding value of the ordinary fodder crops.

They are more widely used than any other fertilisers, and the farmers of the United Kingdom alone purchase something like one and a quarter million tons each year.

Bones.—The oldest form of phosphate used on the farm is obtained from bones. In old days raw bones themselves were much used. Under modern conditions the fat and often the gelatine are first removed, these having considerable commercial value, and the residues are then ground for manure. Sometimes also the bones are treated with sulphuric acid to make the phosphates more soluble. There are thus four bone products obtainable by the farmer:—

(*a*) *Raw bones*, containing the whole of the material, including fat and gelatine;

(*b*) *Bone-meal*, containing the gelatine, but not the fat;

(*c*) *Steamed bone flour*, containing neither gelatine nor fat;

(*d*) *Dissolved bones*, being raw bones or bone-meal treated with sulphuric acid.

Typical analyses are as follows (the figures being percentage constituents):—

	Nitrogen.	*Equivalent to Ammonia.*	*Phosphoric Acid.* (P_2O_5).	*Equivalent to tricalcic phosphate.*
Raw English bones	5	6	22	48
Bone-meal	3·5–4·5	4·2–5·4	20–25	43–55
,, ,, usual analysis ...	3·75	4·5	20·6	45
Steamed bone flour	1–2	1–2·5	25–32	55–69
Dissolved bones	2–3	2·3–3·8	15–16	33–35

Bone fertilisers are very safe, but they are generally less effective than the substances described below. They have not

proved as successful as superphosphate for turnips, or as basic slag for grass. Steamed bone flour, being very finely ground, has proved useful in dry situations; and bone-meal has given tolerably good results for potatoes and for other crops at Rothamsted and at Saxmundham, but at Cockle Park and Aberdeen it did not come out well. There is a belief among certain farmers that dissolved bones are better for the land than superphosphate, but no clear evidence has ever been obtainable in spite of much search for definite instances. On the whole we must conclude that dissolved bones are more popular than they deserve to be.

Superphosphate.—Superphosphate is by far the most widely used of all artificial fertilisers. It is made by treating mineral phosphates with sulphuric acid, and is sometimes therefore regarded as an "acid" fertiliser, but this is incorrect; well made superphosphate has no acidifying effect on the soil. But it is also important to avoid another common error—the assumption that the "lime" referred to in the full name "superphosphate of lime," behaves like lime in the soil and so obviates the necessity for periodical applications of true lime or limestone. *Superphosphate contains no true lime*, and the fact that it is being applied regularly to land does not in the least reduce the necessity for periodical applications of lime. What superphosphate does contain besides calcium phosphate is gypsum, and so much of this is present that the practice of using gypsum as a fertiliser, which at one time was common, is no longer recommended.

Superphosphate is usually sold on its content of water-soluble phosphate, but this is expressed in terms of tricalcic phosphate, thereby facilitating comparison with other phosphatic fertilisers. Thus, when a superphosphate is guaranteed "30 per cent. soluble" it does not mean, as is often supposed, that 30 per cent. of the manure is soluble in water, or that 30 per cent. of the phosphate is rendered soluble, but that the water-soluble phosphate in 100 lb. of the manure contains as much phosphorus (the thing the farmer really wants) as does 30 lb. of tricalcic phosphate.

For Roots.—The most profitable use of superphosphate is on potatoes and on roots. For potatoes it is in practically all conditions the best phosphatic fertiliser we have, and dressings of 4, 6 or even 8 cwt. per acre are often given according to the yield obtainable. In the north (Durham, Northumberland, S.W. Scotland), it has been recommended to use a certain amount of basic slag (2 to 3 cwt.) in partial replacement of the superphosphate. It is not desirable to replace too much, however.

as potatoes are liable to scab if alkaline conditions are set up by the basic slag. Further, it is not certain that heavy dressings of phosphates are always desirable for potatoes; in Devon experiments 400 lb. superphosphate per acre gave a somewhat larger yield than did 533 lb. per acre.

For swedes and turnips superphosphate serves the admirable purpose of bringing them earlier to the hoe than would otherwise be possible. This alone often justifies the use of the fertiliser quite apart from the increase in crop and of feeding value. For these crops, however, basic slag is often equally effective in the north, though not always in the south; but it is always to be preferred wherever finger-and-toe is common.

Mangolds commonly receive a dressing of superphosphate to bring them on earlier, but as a rule there is no point in applying large dressings; probably 2½ cwt. per acre is all that is needed. Indeed there is some evidence that too much superphosphate has the undesirable effect of reducing the growth of the bulb and hastening the ripening of the crop, *i.e.*, the formation of seed.

For Cereals.—Another highly important use of superphosphate is in hastening the ripening of cereals, this being of especial advantage in districts where the harvest is apt to be late. Thus in wet hill districts the harvest is sometimes a source of serious anxiety to farmers and there is a great advantage in expediting it, if only by 6 or 7 days. This has been done by giving a dressing of about 3 cwt. superphosphate along with a small amount (say ¾ cwt.) sulphate of ammonia, to ensure an early development of leaf.

Superphosphate is also used with advantage on barley grown after roots which have been fed to sheep on the land, especially when cake or corn have also been given. It counteracts the rankness that tends to be induced, improving the quality of the grain and increasing the strength of the straw. The same kind of action takes place when superphosphate is added to the nitrogenous top-dressing given to cereals in the ordinary corn-growing districts. Increased yields are obtained by applying nitrogenous dressings to corn crops in spring. There is, however, often the fear that the corn will be laid owing to the inability of the straw to carry more grain. Experience has shown that this tendency is frequently reduced by the addition of 1 to 1½ cwt. of superphosphate to the dressing.

Effect of Soil and Rainfall.—As a rule dry sandy soils in the eastern and midland parts of the country, where the rainfall is

below 25 or 28 in., respond less to phosphates than the heavier soils. Thus superphosphate acts better on the heavy soils of Rothamsted than on the lighter land at Woburn. It is commonly observed on the light lands of East Kent that smaller phosphatic dressings are called for than on the heavier soils. While much depends on the soil a good deal depends also on the rainfall, and a sandy soil under 35 in. of rain will need larger and more frequent dressings of phosphate than a similar soil with 25 in. of rain. With the higher rainfall also there is more possibility of substituting basic slag for superphosphate when the soil is sour or the slag is cheaper.

Although the phosphorus in superphosphate is soluble in water it does not wash out from the soil; it becomes distributed and fixed. At Rothamsted it is possible to account for practically all the phosphate added during the past 70 years; some has gone into the crop and nearly all the remainder is still in the soil, only very small quantities having been washed away.

Basic Slag.—*On Grass Land.*—Basic slag is pre-eminently the fertiliser for grass land, whether pasture or meadow, and it has effected remarkable improvement in cases where it is suitable. It produces its most striking results on heavy land covered with poor herbage containing large quantities of "bent grass" which goes brown in autumn, giving a very parched appearance to the field. The best known instance is that of Cockle Park, where grazing capable of carrying only about 1 sheep per acre and producing only about 25 lb. of live weight increase per acre each season has been so improved that it now carries about 3 sheep per acre and produces about 100 lb. of live weight increase.

The improvement is effected through the agency of the wild white clover which begins to develop soon after the slag is applied. It is therefore essential that the conditions should favour this plant, and for this reason it is wise to adopt a bold policy and give a substantial dressing of slag at the outset. Where drainage is necessary this must receive attention, but there are instances where the wetness of the grass is due not so much to faulty natural drainage as to a mat of moss or decaying vegetation which impedes the soaking away of the water. In such cases the unslagged land may remain wet while on the slagged land the mat disappears and the water gets away naturally.

It is sometimes supposed that slag acts well only if there is heavy rainfall, but this is shown not to be the case by the Essex experiments conducted by Professor G. Scott Robertson. Al-

though the rainfall is not particularly high, slag has improved the yield of hay, raising it from 10 cwt. per acre on the unmanured to 20 cwt. per acre on the slagged land in one of the poorest fields, and from 30 cwt. on the unmanured to 40 cwt. per acre on the slagged land in one of the best fields. Here also the chief improvement is in the type of herbage; the clover increases considerably, and the land is more completely covered with vegetation, with the result that its temperature is lower in summer, there is less wastage of water by evaporation, and in consequence the crop has a larger available supply of water.

Basic slag does not produce these striking results on all types of grass land. Where the herbage is already good enough to carry three, four or more sheep per acre each season there is less room for improvement; this is the case at Rothamsted, and in consequence the grazing experiments are less impressive than at Cockle Park. Similarly the yield of hay on the unslagged land is above that on most Essex slagged plots; hence the improvement is less marked. Further, on light land there is sometimes only little improvement until kainit is added; the combination of slag and kainit then gives a better herbage and larger yields, but there is not always a profit. So on hill land the value of the improvement effected by the slag does not always repay the cost to the farmer; the fault here is not always with the slag, but sometimes with the system of management of the grazing.

On Arable Land.—Although basic slag is best known for its effects on grass land it has in many cases proved useful on arable land also. In the north of England and in Scotland it is recommended for use on swedes and turnips, either in partial or complete replacement of superphosphate, especially where finger-and-toe is common. In the south and west of England it has not generally given as large crops as superphosphate, though under favourable conditions of price it has sometimes proved equally profitable.

Types of Slag.—There are at present three types of slag on the market. (1) The old Bessemer slag with which the Cockle Park experiments were carried out. This contains total phosphorus equivalent to 38 to 42 per cent. of tricalcic phosphate, with a solubility of 85 per cent. by the official citric acid test. Nowadays this type of slag is not common, but a certain amount is still produced in this country, and some is imported from abroad. It seems, however, improbable that large supplies will be maintained.

(2) The present-day open-hearth slag of high solubility containing phosphorus equivalent to 15 to 35 per cent. of tricalcic phosphate, and therefore poorer than the old Bessemer slag. There is no reason to suppose that anything except the phosphate has fertiliser value, and in comparing these slags with the old it is usual and probably sound to do so on the basis of equal phosphate content. Experiments made on these lines indicate that the phosphate in the high soluble slag has on the whole the same agricultural value as that in the Bessemer; in other words, a dressing of 10 cwt. per acre of a 20 per cent. high soluble slag could be expected to have approximately the same effect on grass land as 5 cwt. per acre of a 40 per cent. Bessemer slag.

(3) Some of the open-hearth slag, while containing the same amount of total phosphorus as the preceding material, has a much lower solubility according to the official test. It is not yet clear that there is any great difference between slags of some 60 per cent. and those of 80 per cent. solubility, but it does appear that those of 30 per cent. and still more so those of 20 per cent. solubility are less effective. In the Essex experiments the low soluble slags were less reliable than those of high solubility; sometimes they acted well and sometimes they did not. There is evidence that they are slower in action than the high soluble slags, and hence they should be given time and not expected to work in a hurry; they should be applied in autumn and used preferably in districts of sufficient rainfall. Out of 41 experiments with both types of slag coming under review during the dry season of 1921, 15 of the high soluble were effective, but only 9 of the low soluble.

The comparison of prices of slag and superphosphate is rendered easy by the circumstance that both are sold on the basis of their phosphate content, and although the actual compounds differ in the two fertilisers, they are each expressed in terms of the standard tri-calcic phosphate. Thus, as already explained "30 per cent. superphosphate" means that 100 lb. of the superphosphate contains as much phosphorus as is present in 30 lb. of the standard tri-calcic phosphate. So a "20 per cent. slag" contains in 100 lb. as much phosphorus as does 20 lb. of the standard tri-calcic phosphate. If therefore 30 per cent. superphosphate is offered at £4 5s. each unit costs 2s. 10d.; while if 20 per cent. slag is offered at £3 each unit costs 3s. The price should be worked out to include delivery at the farmer's station.

Solubility of Slag.—There is a further description of basic slag which often causes some confusion—the solubility. This figure

refers to the part of the phosphate which is soluble in the citric acid used in the official test. Thus a 20 per cent. slag of 20 per cent. solubility is a slag 100 lb. of which contains as much phosphorus as does 20 lb. of tricalcic phosphate, and that 20 per cent. of this phosphatic material is soluble in the official testing liquid. A 20 per cent. slag of 80 per cent. solubility would also contain in 100 lb. as much phosphorus as does 20 per cent. tricalcic phosphate, but, of this, 80 per cent. is soluble under the conditions of the official test. This test was designed for the old Bessemer slag and is not equally suitable for the present-day open-hearth slags; data for revision will be available when more field experiments are carried out. In the meantime farmers should regard the solubility figures as having a descriptive rather than an exact value; a slag of 70 per cent. solubility is probably quicker in action than one of 35 per cent. solubility, but it has not necessarily double the value as the figures suggest.

Mineral Phosphates.—These have been used with good results in the United States under the name of rock phosphate; they have also proved effective in France. In the Essex trials they gave promising results, though up to the present they have not acted as well as the high soluble basic slag. A number of tests are in progress in different counties and the results should be carefully watched by farmers. The present indications are that fineness of grinding is important and that the value per unit of phosphate is less than in basic slag.

(This article replaces in this issue the usual notes on manures contributed to the *Journal* by Dr. Russell.)

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GREEN MANURING.

PART II.

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The Mode of Action of Green Manures.—The effect of a green manure on the succeeding crop as compared with that of farmyard manure can be considered under three heads, according to its influence on (1) the supply of mineral nutrients to the main crop; (2) the supply of nitrogen to the main crop; (3) the physical properties of the soil—tilth, moisture-holding capacity, etc.

(1) *Effect on the Supply of Minerals.*—Farmyard manure adds potash and some phosphates to the soil, and these being derived partly from feeding stuffs imported from outside the farm, are a gain to the soil. A green manure, on the other hand, only returns to the soil those mineral substances which it first took from it, so that before it can be equal in its effects to farmyard manure in this respect, it must be supplemented by mineral manures; there is, however, no difficulty about this, and indeed, it always pays to grow the green crops with mineral manures in order to get as large a bulk of green stuff as possible. Further, although the green crop only returns to the soil those minerals it took from it, a deep-rooted green manure crop, by opening up the subsoil, will not only bring up from the subsoil mineral substances which on its decomposition will be added to the surface soil, but also, the ensuing main crop will itself have a better chance of penetrating into the subsoil with its roots, and tapping the mineral resources there. There is also some evidence that a green manure used in conjunction with raw mineral phosphate renders the phosphoric acid of the latter more readily available to the succeeding crop.

(2) *Effect on the Supply of Nitrogen.*—Farmyard manure similarly adds to the soil large quantities of nitrogen. Much of this nitrogen has been purchased, either in the form of cake, or as manures used for the growth of roots or forage crops. The nitrogen in green manures, on the other hand, may be wholly, or largely a clear gain. Thus a leguminous crop collects from the atmosphere large amounts of nitrogen, which are added to the soil, when the crop is turned in. An average crop of vetches may easily add to the soil as much nitrogen as 10 tons of stable manure to the acre. Even a non-leguminous crop, though incapable of fixing atmospheric nitrogen, saves nitrogen for use by the subsequent main crop, by absorbing from the soil nitrates which would otherwise be lost in the drainage water. Green manures therefore may be regarded as comparing not unfavourably with farmyard manure as a means of adding nitrogen to the soil. The relative advantages of green manures and of fallowing on stiff soils are not definitely known. Fallowing is known to have a very beneficial effect on the biological processes of nitrification and nitrogen fixation, both of which are depressed by a growing crop, but on the other hand, the accumulated nitrate of a bare fallow may be lost by leaching in the autumn. Probably the best plan on soils which are known to benefit by a bare summer fallow is that already

mentioned as used in Essex, namely, to fallow during the dry summer months, and sow a green manure in early autumn to save the accumulated nitrates from leaching.

It is not, however, certain that the nitrogen added to soil by green manures is always as readily available to the following crop as that of farmyard manure. This is a point upon which further investigation is needed; the results of the Woburn experiment already quoted illustrate this aspect. Although the amount of nitrogen added to the soil by vetches was found to be markedly superior to that added by mustard, and although analysis of the soil showed that after vetches it was indeed richer in nitrogen than after mustard, yet the wheat after mustard was always a bigger crop than after vetches. Evidently there is some factor operating in the light land at Woburn to limit the availability of the nitrogen buried with the green crop, a factor which is apparently not operative in Rothamsted soil.

Although the nitrogen question is one which undoubtedly bulks large in the value of farmyard manure, and of green manures, it is not the indispensable factor in either. There is no reason to suppose that the requirements of a crop for nitrogen, as for minerals, cannot be adequately met by an enlightened use of artificials. As stated before, it is as a source of organic matter—"humus"—that farmyard manure must be chiefly prized, and it is similarly as a source of humus and by their effects on the physical properties of the soil that green manures must stand or fall.

(3) *Effect on the Supply of Moisture and on the Physical Properties of the Soil.*—We do not know definitely whether, bulk for bulk of dry matter, green manures are as efficient as farmyard manures as sources of humus, nor whether the humus produced from both is of the same character. These are questions which can only be answered after much more work has been done on the general question of humus formation and the nature and properties of humus, and in the meantime we can only assume that humus can be equally well derived from either, and that once formed it will have the same effects in both cases in improving the physical condition of the soil. It is evident then that the difference between farmyard and green manures will be due to the difference in their mode of preparation and application. The essential difference is of course that the farmyard manure is made off the land, and is usually applied only when decomposition is well in hand, whereas the green

manure is actually grown on the land to which it is to be applied, and is so applied in an undecomposed state. During the growth of the green crop important effects are exerted on the moisture content of the soil; on the one hand the transpiration of water by the growing crop dries out the soil, and light showers may not reach its surface; on the other hand, the surface of the soil is screened from the direct action of frost, the beating of rain, and the sun's rays. Whether these actions are beneficial or the reverse, depends, among other things, on the type of soil and the time of year.

The drying effect of transpiration will be of little consequence in the cooler part of the year or on a soil well supplied with moisture, but may be decidedly harmful on a light soil or in a very dry season. The screening of the soil from frost and the beating down of the rain may do no harm, or even be positively beneficial, on a light soil, while a heavy soil may suffer by being screened from frost, though it also probably benefits by being saved from the beating down of heavy rain. Further, the incorporation in the surface soil of undecayed plant material mechanically opens up the soil, and at the same time the capillary channels connecting the subsoil water with the surface are broken. These also are effects which may be beneficial or the reverse according to circumstances. A stiff cold wet soil benefits greatly by the improved drainage caused by this opening up, especially in the wet months of the year, but a light sandy soil which is already too open may be harmed unless the buried crop rots sufficiently quickly to lose its fibrous structure before dry hot weather comes round.

Again, even after the buried crop has thoroughly rotted, the effects of its previous growth may persist and influence the growth of the succeeding crop, either as a result of the drying out of the soil previously mentioned, or in the case of a deep-rooted green crop, by opening up the subsoil and enabling the ensuing crop to draw on supplies of subsoil water which it would not otherwise obtain. A striking illustration of this effect of a deep-rooted green manure crop is reported by Schultz, to whose pioneer work at Lupitz, in Saxony, so much of our knowledge of the principles of green manuring is due. Schultz grew potatoes on plots which had previously been green manured with lupins, and on adjacent plots which had received a dressing of farmyard manure of equal nitrogen content. The crops of potatoes were weighed and the depth to

which their roots penetrated was also determined. The results obtained were:—

Depth of rooting and yields of Potatoes after green manuring with lupins. Schultz—Lupitz. (Light sandy soil).

	After lupins.	*After farmyard manure.*
Depth of penetration of roots	47 in.	15-17 in.
Yield of tubers per acre	9 tons	6 tons

In a similar experiment with rye the results were :—

	Rye after lupins.	*Rye after potatoes and heavy dressing of artificials.*	*Rye on poor arable land.*
Height above ground...	47-66 in.	27-37 in.	20-35 in.
Depth of roots... ...	45 in.	20 24 in.	16 in.
Yield of grain per acre	27 bush.	12 bush.	9¾ bush.

Space does not permit of a more detailed discussion of the mode of action of green manures, but it is hoped that the above remarks will serve to illustrate not only some of the reasons why under suitable conditions green manuring may have such beneficial results as it is known to have but also, how the attainment of success with green manures depends on a careful consideration of the actual conditions of soil, climate, etc., in the locality concerned. We thus come finally to the consideration of those practical questions on which ultimately the success of any system of manuring depends. We have seen that it is possible to obtain considerable crop increases by green manuring, and indeed that in certain districts in this country the system is used with success, and we have examined the factors which are operative in determining the action of green manures. What we now have to consider is how existing knowledge can best be applied in practice. It is not surprising that different soils, and districts with different climates, respond differently to similar methods of green manuring, and the knowledge at our disposal at present does not enable us to do more than suggest what are likely to be satisfactory systems to suit specified conditions. Many more careful experiments are needed before one can say with any degree of certainty what is the best method under given circumstances.

The Practical Problems of Green Manuring.—The practical problems fall into two parts: green manuring may be required either to maintain the fertility of land already yielding profitable crops; or to build up the fertility of poor waste land or of land which is badly run down and in danger of being no longer profitable to farm. In the first case, that of *maintaining* the fertility of the soil, it is obvious that the system adopted must interfere

as little as possible with the normal cropping. This rules out the possibility of giving the whole, or a large part of the growing season to a green manure crop, and it becomes necessary to take advantage of the intervals in the normal rotation. Now in ordinary farming on a standard four-course rotation, the only intervals usually available will be: (a) From the wheat harvest until the roots are sown the following spring, and similarly after oats or barley when seeds have not been sown with them in the spring, (b) From the time the roots are lifted until the spring corn is sown. As regards (b) mangolds or swedes and main crop potatoes are lifted too late for a catch crop to be put in, so that it is only when these crops have failed or after early potatoes or white turnips that this interval can be utilised.

Where a less rigid rotation is followed, as in market gardening districts, and even in ordinary farming now that the tractor has made possible much greater elasticity in rotations, many more favourable opportunities of catch cropping with green manures present themselves.

Suitable Crops.—It is thus clear that catch crops must be used which are able either to make rapid growth in the late summer and in autumn, or which can withstand the winter. The best crop to use depends very much on the district, but the widespread use of mustard is due to the very rapid growth it makes even on poor soils, so that if sown on the stubble in August, or even early September, it will give a good stand for turning in before winter corn or when the heavy frosts come on in November or December. Other crops which are to be recommended in districts where they are known to do well, are rye, oats, Italian rye grass, buckwheat (which does well on poor light soils), rape (giant or ordinary), and thousand-headed kale; all of these in a good season may give a good bulk of green stuff by the end of the autumn. In the case where the crop can be grown on through the winter for turning under in January or February before spring corn, or even later, before roots, other crops to be considered are vetches, crimson clover, red clover, winter beans, late swedes or turnips, and winter oats, rye or barley.

It is generally the case that a leguminous crop is to be preferred to a non-leguminous one, by virtue of its power of gathering nitrogen, but the Woburn results show that this is not always true, and in any case, since it is bulk of organic matter, rather than nitrogen which is primarily to be aimed at, the crop should be chosen which will give the largest growth in the time available and then, other things being equal, preference should be given

to a deep-rooted, nitrogen-gathering crop. The system of green manuring already mentioned as finding application in the Biggleswade district, and elsewhere, in which the green crop is sown with the spring corn, and turned under in the autumn or early in the following year, merits a more extended trial, and has the advantage that less rapidly growing legumes such as serradella, sainfoin, lucerne, and white, alsike, hop or Bokhara clover can be used. There is much scope for the trial of new crops not previously grown to any extent in this country. Among such may be mentioned an annual sweet white clover, *Melilotus alba*, var. *annua*, which has lately come into prominence as a fodder and green manure crop in the United States. Some seed of this crop has recently been obtained at Rothamsted, and is to be tried during the coming season. Soy beans also are used as green manure in America and could profitably be tried in this country. One of the chief difficulties liable to be met with in green manuring is that the catch crop has often to be sown in very dry soil, with somewhat uncertain prospects of good germination. Here again, there is much scope for the introduction of new varieties specially adapted to give good germination and growth under dry conditions.

When to Plough in.—A point needing careful consideration is whether green manures preceding a spring-sown crop should be turned under at the beginning or the end of the winter. This depends to a large extent on the district. On a light soil, where decomposition is rapid and leaching considerable, it is probably best to leave the crop above ground as long as possible. Such a soil does not suffer appreciably by being protected from the action of frost, while if the crop is turned under at the beginning of the winter, decomposition may have proceeded so far by the spring that a large part of the nitrogen will have been lost in the drainage water. The results of the Wisley experiments quoted above illustrate this point. On a stiff soil, however, rotting is slower, and leaching much less, while the mechanical action of the unrotted plant material in facilitating drainage during the wet season will be beneficial, so that on such soils it may be better to turn the crop under earlier, say in early December, so that the heavy soil may be exposed to the beneficial action of the hard frosts.

Another practical point to be borne in mind is the minimum time which should elapse between the turning under of the green crop and the sowing of the succeeding main crop. In some cases failure of the main crop has been found to occur if the in-

terval has been too short. This may be due to some check on germination by the primary products of decomposition of the green manure or to the action of fungi, but this harmful action disappears in a short time, and it may be taken that an interval of about one month is sufficient.

Green Manuring for Land Reclamation.—In dealing with the second part of the problem, that of building up the fertility of waste or exhausted land, greater opportunity for green manuring is available. On such land, which with ordinary farming brings in little or no profit, the green manure can be grown as part of a special rotation in which the whole of a growing season is given up to the green crop, or a series of green crops. For poor, light sandy soils, in cases where the application of lime is too costly, blue lupins are a very suitable crop, and the results obtained in Germany by Schultz, and more recently in Suffolk and Notts., as already quoted, show with what success such a method may be used. Where lime can be applied, many more crops are available; field peas, horse beans, and the like merit consideration, and choice can also be made of such of those crops mentioned in the preceding paragraphs, which are suitable to the soil concerned.

Manuring of the Green Crops.—In order to get the best possible growth of green crops, a sufficient dressing of phosphate should always be given, together with potash if there is any indication of its being needed. A moderate dressing of nitrate of soda or sulphate of ammonia will also often be beneficial, in giving the crops a good start, especially for crops sown on the stubble, where nitrates will be at a low ebb.

Method of Turning in the Green Crop.—With regard to the actual turning under of the green crop, if the latter is very dense, it should be gone over in front of the plough with a disk-harrow or roller, or an extra horse should be put on in front of the team to help trample down the crop. It may also be necessary to fix a heavy chain on the plough and to use a disk coulter. As to depth of burial, it is generally found that shallow burial, 5 in. to 6 in. is as good as, or better than deep burial. There is also some evidence that the rotting of the buried crop is expedited if a very light dressing of stable manure is ploughed in with the green crop.

What Crops benefit most by Green Manuring.—There is some evidence that hoed crops such as potatoes, sugar beet, mangolds, and turnips, benefit more than others by green manuring,

and since the interval between wheat and roots in the ordinary four-course rotation is the one in which green manuring with catch crops can be most easily fitted, more attention should be directed to the use of green manure for these crops. Green manures for winter wheat appear also to be undoubtedly of great benefit, though it is apparently for wheat especially that there appears to be some uncertainty as to the relative merits of leguminous and non-leguminous crops.

The Economic Value of Green Manures.—In conclusion, it must be pointed out that we are not in possession of precise data concerning the economic value of green manures. The fact that they find extended application in many places abroad and in special districts of this country is good evidence that their use in many circumstances is economically sound, but in considering them as an alternative to animal manures we are brought up against the vexed question of whether the keeping of animals merely as manure-makers is an economic proposition. There is no doubt that on light lands, the standard system of feeding green crops to sheep folded on the land will hold its own against green manuring in many districts, but after all, there is a limit to the number of sheep any farmer can keep, and many specialist growers would prefer to do without them; moreover, some of the poor light lands like those of Suffolk are not suitable to sheep.

On heavy lands it is often not practicable to fold sheep on the arable fields, and on such lands, if green manuring is not adopted, all the animal manure which is required beyond that given by the stock normally kept for fatting or dairy purposes, must be provided by extra cattle kept primarily for the manure they provide, or must be bought in. By going in for green manures, the farmer could wholly or partly dispense with these extra cattle, could reduce his area under roots and forage crops, and use a greater proportion of his land every year for growing marketable crops. Although in some circumstances a green manure crop itself may encroach somewhat on the time the land is available for growing a marketable crop, it must be remembered that this may be more than made up for by the increased crops obtained, and by the fact that in growing a green manure on the land to which it is to be applied, all charges for carting and spreading dung are avoided. With prevailing prices of feeding stuffs and of labour the cost of producing and applying animal manure to the land is undoubtedly very many times that of the same amount of organic matter and nitrogen applied as green manure.

COUNCIL OF AGRICULTURE FOR ENGLAND.

THE Eighth Meeting of the Council of Agriculture for England was held on 18th May, 1922, at the Middlesex Guildhall, Westminster. The chair was taken by Sir Douglas Newton, M.P., K.B.E., who was elected Chairman for the year 1922. The Minister of Agriculture, Sir Arthur Griffith-Boscawen, M.P., was present throughout the proceedings.

Statement by the Minister.—At the opening of the meeting, the Minister made a statement on the agricultural situation, covering the main items of importance since the meeting of the Council in December last. He referred first to the depression in agricultural prices which had come upon the industry with appalling suddenness. Farmers had, in consequence, been in great difficulties, and landlords had been unable to come to their assistance. Since January last, however, there had been signs of improvement. The help which had been given when things were really at their worst by the payments in lieu of guaranteed prices had certainly come at an opportune time. Of the 187,000 total claims, 150,000, or 95 per cent. of the claims made up to 18th July, 1921, were paid on 1st January last. Over 5,000 more were paid in the first week of January, and nearly all the remaining claims had been paid by the end of January.

With regard to the question of wages, the farmer could not possibly continue to pay the wages which he was paying a year ago in the face of a 50 per cent. decline in prices. The necessary reductions had been carried out through the Agricultural Conciliation Committees, generally, he was glad to say, in a spirit of goodwill and with very few disputes. There were 61 Conciliation Committees in England and Wales in place of 39 old District Wages Committees; 54 of these had made agreements, of which 44 were now current. Most of the agreements were for long periods.

The Minister then referred to the foot-and-mouth disease outbreak, which had been the worst in the country since the year 1883. He expected that it would cost not less than £1,000,000 to stamp it out, although, having regard to the value of the live stock in the country and the nature of the disease, the money will have been well spent if the disease is entirely eradicated. It had been stated that a large proportion of the live stock of the country had been slaughtered. As a matter of fact, there had been slaughtered, as diseased or in contact, 22,000 cattle, or

one-third of 1 per cent. of the total, 20,000 sheep, or one-tenth of 1 per cent. of the total, and 9,000 pigs, or one-third of 1 per cent. of the total.

Turning then to the recommendations of the Geddes Committee, which Committee, he said, had performed a very valuable service to the country generally, reductions of the Ministry's expenditure had been proposed which he had been unable to accept. Before the Geddes Report, the Ministry had itself made a reduction amounting to about 36 per cent. of its expenditure. The Committee, nevertheless, proposed further reductions and suggested that the live stock scheme, including the bull and boar scheme and the milk recording scheme, should be stopped. He had, however, been able to convince the Cabinet that they should be retained. As regards the grants for agricultural education and research, the Committee had suggested that, in view of the extra £1,000,000 which had been acquired for Agriculture under the Corn Production Act (Repeal) Act, there ought to be a big cut in the amount which we had been spending upon that subject before the grant had been obtained. To carry out such a proposition, however, appeared to the Minister to involve a most distinct breach of faith with the agricultural community. He, therefore, with the aid of the Secretary for Scotland, whose Department was affected in the same way, had been able to make his case good before the Cabinet, and the original grants for agricultural education and research were accordingly retained. The share for England and Wales (£850,000), as to the allocation of which the Agricultural Advisory Committee had been consulted, would be spent, as far as possible, on large and important services, such as the proposed new institute for Veterinary Research. The Minister here outlined the main items which the proposed allocation covered. He went on to say that during the last few months a good deal of work had been done for the relief of unemployment by means of land drainage work. A grant of £650,000 had been obtained for land drainage, of which about £400,000 had been spent on 363 schemes which had been sanctioned. Ditches and watercourses had been cleaned out and land rendered cultivable which formerly had been water-logged. To-day, about 8,000 men were being employed and valuable work was being accomplished.

Within the period under review, the difficulty as to milk prices had been settled, with the result that farmers got 2½d. per gallon more for their milk for the next six months than they would have done under agreements many of which had already been signed.

The duties on home-grown sugar had also been remitted, and he hoped that this would lead to the firm establishment of the sugar beet industry in the country. Then there had been a very valuable concession to farmers in regard to income tax. On the question of the burdens on land, he agreed that rates were too high, and thought that land was unfairly assessed; and he was considering what means could best be recommended for dealing with the matter. He was glad to say that there were no very important agricultural bills now before Parliament. Two measures, however, he would mention: (1) a Consolidation Bill of the various Agricultural Holdings Acts, and (2) the Allotments Bill. Both were admirable measures of their kind. He would conclude upon a note of optimism. We had been going through dark days, but he hoped and believed that there was a brighter future in store for the industry.

Mr. Donaldson proposed, and Lord Bledisloe seconded, a vote of thanks to the Minister for his address.

Importation of Store Cattle.—The first of the motions down on the Agenda, moved by the Earl of Northbrook and seconded by Mr. James Hamilton (Lancs) was as follows:—

> "That the Council of Agriculture for England re-affirms the resolutions which were passed at the Meetings held on 4th March and 22nd November, 1921, to the effect that the existing restrictions on the importation of store cattle should be maintained."

Lord Northbrook said that he was most anxious that Canada should have fair play in this matter, and that any slur which the Canadian farmers might feel has been placed upon them should be removed; and he was further anxious, like every other Englishman, that any definite promise given by the British Government should be honourably fulfilled. But he thought that the Council should also claim fair play for British agriculture and the faithful redemption of the promises which had been made on so many occasions to the farmers of this country. In view of the position in which the matter now stood, he hoped that the Minister would be able to assure the Council that the Government were not weakening on the question.

Mr. James Hamilton said he could not make it too clear that there was no question raised as to the health and soundness of Canadian cattle. The "embargo" was applied to all countries. The Act of 1896 keeps all store cattle from over-seas out of the country. The present agitation had been raised with a view to reducing the cost of living. The argument of the agitation was that the restrictions on the importation of stores should be

removed so that they would become very plentiful and thus reduce the price of beef. The assumption was that the price of stores was a considerable factor in determining the price of beef. Sir Daniel Hall had pointed out in his evidence before the Royal Commission that the price of home-fed beef was determined by the price of chilled beef. The experience of the last two years had been such as to confirm this statement.

Mr. E. G. Owles (Norfolk) said that Norfolk as a whole was strongly in favour of lifting the embargo so far as Canadian cattle were concerned. At a meeting held in Norwich in March last, when at least 1,000 farmers were present, four only had voted in favour of the embargo. There were only two ways in which a larger and cheaper supply of home-bred fat beef could be had, and these were (1) by admitting Canadian store cattle, or (2) by requiring that no calf suitable for rearing should be slaughtered under six months old. The latter method had the disadvantage of tying up cows with their calves for a time instead of producing milk for human consumption.

Mr. J. R. Spraggon (Durham) asked how many of the 1,000 people at the Norwich meeting were farmers. A similar meeting in Northumberland had been reported to be a farmers' meeting and was not.

Mr. W. R. Smith, M.P., said that the question at the moment was Canadian cattle, and it was important that the issue should not be clouded by reference to the cattle from other countries. He had been present at the meeting in Norwich to which Mr. Owles referred and could unhesitatingly say that the meeting was one of *bona fide* farmers. Before altering his view, he would want more sufficient reasons why the embargo should not be removed, thus giving the farmer a better chance in his business.

In opposing the motion, *Mrs. Middleton* stated that at the meeting in Northumberland to which Mr. Spraggon had referred, which was held in March last and presided over by the Duke of Northumberland, there were between 450 and 500 people present and only two voted in favour of retaining the embargo. The Mother Country should not take as her motto "Safety first." It should be looking to the safety of her children as well as herself. Production should be founded on the principle of competition, co-operation and common sense.

Lord Bledisloe asked whether the interests of Canadian farmers were to be placed before the interests of the majority of English and Welsh farmers, and whether, if the embargo were to be raised, Canada was to remain the exception to the rest of the countries of the world. He foresaw very serious difficulties,

diplomatic and otherwise, if any exception were commenced. Nine-tenths of agriculturists were opposed to the removal of the embargo which for a quarter of a century had assisted the cattle-breeding industry to an amazing extent and offered the country the greatest protection against starvation in time of war. Was the House of Commons, without any appeal to the country on the subject, going to decide the matter and remove the embargo, thus laying the country open to the dangers which the Council knew would be awaiting it if such a thing happened?

The Minister outlined the position of the Government in the matter, and said that he was quite content to abide by the decision of the Council. He pointed out that there was no such thing as a Canadian embargo, as such. The policy of taking no store cattle from anywhere overseas had been followed for the last twenty-six years and had been extraordinarily successful. Till this year we had had practically no disease and our flocks and herds had steadily grown. Parliament would have no right to alter the deliberate policy, so long carried on by Governments, Liberal and Conservative, with regard to live stock, which was the most important side of the agricultural industry, without real and sufficient reason. He then dealt one by one with the reasons that had been brought forward, and said that he saw no argument which would lead him to depart from the attitude taken up by his predecessors, and that he would speak and vote and do his utmost to defeat the resolution in favour of removing the embargo when it came before the House of Commons.

Mr. George Edwards, M.P., then spoke in favour of the removal of the embargo and said he did so in the interests of agriculture.

Sir Merrik Burrell referred to Lord Northcliffe's recent speech and mentioned a statement which had appeared in the *Times* of 15th May, being a quotation from the *Montreal Star*. He was more prepared to place reliance upon that than upon statements of certain newspaper leaders. The value of the agricultural industry could not be measured by mere voting power. As the country became more and more industrial, so the value of the agricultural industry increased. All questions of agriculture should be outside party politics.

Mr. H. German (Leics.), speaking as Vice-President of the National Farmers' Union, representing 54 out of 56 branches and 600 local branches, said that the Union had a mandate from them to oppose the lifting of the embargo. He made the offer

to Mr. Smith and Mr. Edwards to come as his guests to one part of England which would be turned into desolation if Canadian cattle were admitted. He was also prepared to go down to Norwich and prove to the people of Norfolk that it was in the national interest that the embargo should be kept on.

The motion was then put to the Council and passed by a vote of 60 against 11.

Milk and Dairies Act, 1915.—The Right Hon. Lord Strachie moved :—

> "That in the opinion of this Council it is undesirable to amend or repeal the Milk and Dairies Act, 1915, before it is put into operation."

In moving this resolution, *Lord Strachie* said he thought the safeguards in the Act had been completely misunderstood. The National Farmers' Union were proposing alternative legislation dealing with several complicated points and it put forward no suggestions for similar safeguards. The Act of 1915 was a compromise and, like other compromises of the kind, would probably work satisfactorily. It was laid down in the Act that no Order should be issued by the Minister of Health except with the concurrence of the Minister of Agriculture, and also that Orders could not come into force until they had been laid on the tables of both Houses of Parliament for forty days, during which time objection could be taken to them. The Central Chamber of Agriculture, the Bath and West Council and also the Central Landowners' Association had approved the course proposed in the motion.

Mr. H. C. Gardner (Worcs.) seconded the motion and *Lord Northbrook* and *Lord Bledisloe* spoke in favour of it. *Mr. J. Donaldson* (Oxford) opposed on the ground that the proposals which were now in contemplation at the Ministry of Health were more in accordance with our present requirements. *Mr. George Dallas* considered that the interests of the community were for a pure milk supply, and that the Council ought not to attempt in any way to interfere with regulations which would help to produce such a supply. *Mr. German* agreed with Mr. Dallas. He thought that it was also necessary to provide a sufficient quantity of milk so that no child should be in want of it. The British farmer is prepared to put pure milk on the market, but the milk as it reaches the consumer is not as produced by the farmer. He thought it was the wrong time to bring up regulations which involve supervision of a number of points, such as cleaning udders, washing hands, scalding buckets, etc., and he therefore opposed the resolution.

Sir Daniel Hall, who was appointed to speak on behalf of the Ministry in the matter, said that the estimates of the cost of the Act of 1915 were such as to put the possibility of working it at the present time out of the question. The Ministry of Health would need £700,000 per annum for the Act, and the Tuberculosis Order, which the Ministry were to operate side by side with the Act, would cost another £75,000 per annum. In these circumstances, another Bill had been prepared by the Ministry of Health, who had consulted the Ministry of Agriculture upon it, and it was the Minister's intention within the course of a week to ask the advice of the Agricultural Advisory Committee on the new proposals.

Mr. Christopher Turnor spoke as to the food value of milk, and the desirability of increasing its consumption and in particular of purifying the supply. *Sir Merrik Burrell* then moved the adjournment of the debate until the provisions of the new Bill had become available. *Sir Arthur Hazlerigg* seconded, and after some further discussion, the motion, to which Lord Strachie was not averse, providing the Minister of Agriculture and Parliament retained their powers of vetoing Orders, was put to the meeting and carried. *The Minister* assured the Council that due weight should be given to the point raised by Lord Strachie.

Wart Disease of Potatoes.—*Mr. A. G. Daniels* (Herts) moved:—

"That this Council learns with the gravest possible concern that modifications of the Ministry's scheme for the control of Wart Disease of potatoes are proposed; and it is of opinion that any policy which reduces the activities of the Ministry in controlling the disease will have a detrimental effect and will militate against real economy and food production; and it further urges that the policy of 1921 be pursued and embodied in an Order of the Ministry."

He understood that proposals to amend the policy of 1921 had been put forward in order to save £5,000 per annum on administrative expenses. The policy of 1921 had been carefully considered by the Potato Advisory Committee and had been approved by the Agricultural Advisory Committee. The Ministry had been doing admirable work, and the 1921 policy would give them better opportunities to control the disease. The new proposal was a retrograde step. *Mr. R. R. Robbins* seconded the motion. He reminded the Council that in 1919 there were 3,000 outbreaks of Wart Disease and that in 1921 that number had fallen to 300, so that it might not be a real economy to save £5,000 per annum and scrap a policy built on lines which had proved successful.

Sir Daniel Hall suggested that the grounds upon which the latest proposals were made were being rather misrepresented. The change was not one that was proposed merely for the sake of saving £5,000 per annum: there was a definite change of policy suggested. The original measures largely depended upon the fact that in certain areas in the country only immune potatoes could be grown. It was found that such a requirement inflicted an intolerable hardship upon certain of those localities, and the Ministry decided to concentrate their efforts upon ensuring that a supply of guaranteed pure seed should be secured for growers, whether the variety required was a susceptible or an immune one. That change of policy was common both to the 1921 policy and to the new 1922 policy. The difference was that the last-named policy went still further in the direction of safeguarding the seed and let the other part of the administration go, thus effecting a desired economy. The latest proposals, however, had not been accepted by the Potato Advisory Committee or the Agricultural Advisory Committee. The Ministry were therefore considering a fresh revision which would be submitted in due course to the two Committees named.

Mr. Gardner, speaking as a member of the Potato Advisory Committee, said that he was not at all sure that the 1921 Order, which had never been put into force, would, if operated, give the same good results as were achieved under the old Order.

The motion was then put to the meeting and passed.

Allotments Bill.—*Mr. J. Forbes* moved :—

"That this Council welcomes the introduction of a Bill to amend the Allotment Laws and gives its support to any measures which are designed to make land more easily available for allotments and to improve the security of tenure of occupiers of allotments."

He said that there were to-day as many as 1,330,000 allotment holders in England and Wales, and the great bulk of them were in industrial and urban areas. The Bill was the result of the recommendations of a Departmental Committee and he urged the Council to give it all possible support.

Mr. George Nicholls (Soke of Peterborough) seconded the motion, and said that the way in which allotment holders had been holding on to their land since the departure of war conditions had been a great surprise to many who had been in touch with the work over a long series of years. *Lord Bledisloe* also spoke in favour of the motion, which was then put to the meeting and carried.

Destruction of Rabbits.—*Mr. Donaldson* moved :—

"That this Council regrets the delay of the Minister of Agriculture in introducing a Bill to provide for the destruction of rabbits, as requested by this Council, and is further of the opinion that, as this body may be taken to be entitled to speak for County Agricultural Committees, which would in fact administer the Act, any objection on the score of administrative difficulties cannot be regarded as warranting the non-introduction of the measure."

He said that the rabbit pest was becoming a great nuisance to agriculture, and that the legislation asked for should be pressed on by the Ministry notwithstanding objection from the County Councils Association. That Association did not represent agriculture, and therefore should not prevail.

Lord Bledisloe seconded the resolution, pointing out that there was no opposition whatever from landlords in regard to this question. *Mr. Christopher Turnor* also supported the resolution.

The Minister said that it was not fair to say that the Bill had been turned down by the County Councils Association. The need for economy at the present time is imperative, and he desired to have the concurrence of the Association as the expense would have to be borne by the County Councils. The Association had a meeting on 24th May, and he hoped, after their reply, to be in a position to push the matter forward. *Lord Strachie* said on behalf of the County Councils Association that they were not hostile to the proposal but only anxious as to the cost of the measure. The motion was then put to the meeting and carried.

Reports.—The Council received the Report of the Sub-Committee to consider the question of providing further credit facilities for farmers, the Half-yearly Report (No. 3) of the proceedings of the Agricultural Advisory Committee (printed at p. 257), and the Memorandum which the Ministry had prepared containing their proposals to make the Annual Agricultural Returns compulsory. In moving the reception of the first-named Report, *Mr. G. G. Rea* (Northumberland) said that the report was not by any means so far-reaching as the Sub-Committee would have liked to make it. They were guided by two important principles, the first to get something done quickly, and the second to avoid heavy expenditure. The recommendations in the report followed those principles.

AGRICULTURAL ADVISORY COMMITTEE FOR ENGLAND AND WALES.

THE following is the half-yearly report (No. 3) of the Agricultural Advisory Committee for England and Wales to the Councils of Agriculture for England and Wales, on the Proceedings of the Committee :—

Since the date of the last report,* the Agricultural Advisory Committee has met seven times, two of the meetings being special meetings to consider the position in regard to Foot-and-Mouth Disease. The following subjects were considered, with the results stated :—

(1) **Restrictions on Exportation of Artificial Fertilisers.**—In the last Report it was stated that the question of the final removal of these restrictions had been brought before the Committee, and consideration deferred by it for a month. It had in the first place been explained that an Order in Council under the Fertilisers (Temporary Control of Export) Act, 1920, prohibited the export of sulphate of ammonia, superphospate, basic slag, and compound manures containing any of these, except by licence of the Board of Trade. An open general licence had already been issued authorising export of sulphate of ammonia.

The restrictions had been imposed at a time when the stocks of fertilisers in the country were low. This position had altered; large stocks had accumulated, and manufacturers were making an insistent demand to be allowed to export. The only fertiliser that was, as a matter of fact, really being restricted in export was high grade basic slag; and now about 600 tons were required to be exported. It was represented that this could be allowed without injury to agriculture. If there was likely to be a shortage of slag in this country it was considered that the restrictions could be reimposed. The Committee agreed to the Ministry advising the Board of Trade to allow exportation as suggested, the position in regard to the supply and home requirements of artificial fertilisers to be kept under observation from week to week.

(2) **Importation of Goats for Breeding Purposes.**—The British Goat Society had asked permission to import pedigree goats for the purpose of improving the breed of animals in this country. No importation had been made since 1903, and it was suggested that the time had arrived when another importation under suitable conditions of quarantine might be effected. It was agreed that the request might be acceded to, the British Goat Society purchasing the animals to be imported and arranging the importation as their own affair, the Ministry prescribing the necessary quarantine and conditions of importation.

(3) **Proposed Rabbit Pest Bill.**—The following Resolution of the Council of Agriculture for England was considered :—

"That the Council recommends the Ministry to promote legislation on the lines of Section 10 of the Corn Production Act, 1917, recently repealed, with the object of enabling Agricultural Committees to deal with the

* This *Journal*, January, 1922, p. 942.

rabbit pest in cases where damage to crops and plantations is sustained by the attacks of vermin from adjoining occupations."

The Committee recommended that a Bill should be drafted on the lines suggested. This was done and referred for observations to the County Councils Association. The matter was again considered by the Committee after these observations had been received and it was decided to recommend that the Bill should be proceeded with, notwithstanding that the County Councils Association were not satisfied that there was any necessity for legislation in the form proposed.

(4) **Scheme for the Voluntary Registration of Bulls.**—This Scheme, which had been referred back to the Committee by the Council of Agriculture for England for further consideration, was put by to come up again when the voluntary scheme of registration now proceeding in Buckinghamshire had developed.

(5) **Importation of Store Cattle.**—At its meeting on the 14th December, 1921, the Committee passed a resolution in the same terms as that which had been passed at the meeting of the Council of Agriculture for England on the 22nd November, 1921.

(6) **Provision of Telephones at Railway Stations Goods Yards.**—It was reported that the Controller of Horticulture had brought the question of the provision of telephones at five railway goods stations where it was needed to the notice of the Ministry of Transport and the Railway Company concerned. As a result, a promise had been made by the Company that telephones would be installed at three of the five stations in question. Exception was taken in the Committee to the fact that this action did not meet the general question of the lack of telephone facilities. The following Resolution was accordingly passed:—

> "That in the opinion of this Committee all railway goods stations at which farm produce and supplies are dispatched or received should be connected with the public telephone forthwith."

Further representations were made to the Ministry of Transport, and the Ministry of Agriculture were informed that Railway Companies were not prepared to instal telephones at stations where they do not consider that the traffic warrants such a course, or would make it a remunerative proposition from the Railways' point of view. The Ministry of Transport, moreover, felt that the general question of the provision of telephone facilities at railway goods stations was not a matter that should be taken up by the Interdepartmental Committee on the Transport of Horticultural Produce, and it was that Ministry's view that the best course was to take up each individual case as it arose with the Railway Company concerned. The Agricultural Advisory Committee agreed that in the circumstances no general action appeared to be possible and that the only practicable policy was that suggested by the Ministry of Transport.

(7) **Railway Rates for Agricultural Produce.**—On considering this general question the Committee passed the following Resolution:—

> "That this Committee strongly urges on the Ministry the absolute necessity of making representations forthwith to the proper quarter as to the unduly high railway rates which exist on agricultural produce at the present time, as there is no doubt that they constitute a serious handicap to the agricultural industry."

A Memorandum was drawn up stating the legal position in regard to proceedings before the Rates Tribunal* and referring incidentally to the position of the Ministry in the matter. It appeared that under the new legislation the Ministry, as such, had no *locus standi* in any appeal which might be made, though it could as heretofore make representations to the Railway Clearing House or to individual Railway Companies in specific cases. As a result of further discussion in Committee, the Minister communicated with the Ministry of Transport on the question. That Department agreed that the Ministry could not appear before the Railway Rates Tribunal as a matter of right on behalf of agricultural representations. At the same time, the Minister promised that everything would be done by the Ministry to assist agriculturists in making their representations to the Tribunal.

(8) **Foot-and-Mouth Disease Outbreak.**—Soon after the discovery of the disease in the country, the Minister called a special meeting of the Committee and informed them of the main facts of the outbreak and of the measures taken to arrest it. The Committee agreed that the policy adopted appeared to be the right one in the circumstances. The Minister pointed out that there was no justification for any rise in the price of meat, such as was then taking place, because of the slaughter of the comparatively small number of animals involved in the protective measures. On the question of policy, the value of the flocks and herds might be estimated at somewhere near £312,000,000, and if a policy of isolation and treatment were adopted with the practical certainty of the spread of the disease throughout the country, a very serious loss to farmers and to the community would be incurred. Some special proposals were made for dealing with valuable pedigree stock by isolation rather than slaughter should they contract the disease, and points of detail arising out of the conduct of the general operations were discussed. The Minister arranged to call the Committee together again immediately in the event of the disease spreading widely and becoming epidemic.

A further special meeting was held on the 23rd February to consider the question of expenditure on Foot-and-Mouth Disease. It was reported that although the outlook in regard to stamping out the disease was not unpromising, expenditure was mounting, so that the question had to be considered whether an extension of the very restricted use of isolation might not be made. The following Resolution was adopted:—

> "That this Committee strongly urges the Minister to continue the present policy of slaughter for another two weeks, providing for isolation where this can reasonably be carried out."

Reports of the position in regard to the outbreak were made at each subsequent meeting of the Committee and advice requested upon several points of principle and practice arising in the course of the operations against the disease. There has been no occasion to depart from the general policy of slaughter, with isolation in a comparatively few cases.

(9) **The Allocation of the Grant of £850,000 for Agricultural Education and Research.**—As mentioned in the previous Report to the Council, a Sub-Committee of the Agricultural Advisory Committee had been appointed to go into the details of this matter with the Ministry and to report to the Committee. A statement embodying the main conclusions arrived at by this Sub-Committee was considered at the meeting of the Committee on the

* This *Journal*, April, 1922, p. 41.

8th March. It was reported that the Treasury had agreed to the expenditure of the sum in question, with interest, in the next five years, and that the existing grants in respect of agricultural education and research should be retained. It was understood that further funds for the annual maintenance of the work thus commenced or developed would be forthcoming after the five-year period. The Committee approved the proposals subject to certain conditions and assurances which were duly recorded.

(10) **Credit Facilities for Farmers.**—It will be remembered that a Sub-Committee was appointed at the request of the Council of Agriculture for England to consider this question. The original terms of reference which were stated in the last Report to the Council were extended by the Agricultural Advisory Committee in order to enable the Sub-Committee to consider the question of long term credit in cases where owners had recently purchased their farms. The Sub-Committee presented its Report to the Meeting on the 8th March last, and it was accepted. The Report was framed on the understanding that it would be possible for the Government to give effect to most of its recommendations without the need of waiting for legislation. The Agricultural Advisory Committee was informed, however, at the time of presentation of the Report, that this was ascertained by the Ministry not to be possible in the circumstances then existing, there being no funds available with the Development Commissioners for the purpose. At a later Meeting of the Committee it was stated that the matter had been laid before the Chancellor of the Exchequer and that he had been unable to do anything so far and hesitated to do so because of the difficulty of resisting claims of other industries which were at the present time also hard-hit financially. The Minister told the Committee that he thought the issue was one which should be explored by a Departmental Committee which might endeavour to suggest the most suitable line of action through co-operative credit associations.

(11) **Proposed New Modification of Wart Disease of Potatoes Policy.**—In the last report to the Councils of Agriculture it was noted that the Wart Disease Policy, which had obtained for some years, was to be revised. Owing to the fact that decreased funds were available for the Ministry's work, it was found necessary to suggest that the revised policy should be amended and the measures taken by the Ministry in the matter much simplified. The Potato Advisory Committee, however, sitting on the 2nd May, disagreed with this proposal and passed the following Resolution:—

> "That this Committee recommends the Ministry to put into force the suspended 1921 policy, subject to such amendments as the Ministry's experts may deem advisable as to the scheduled areas in Scotland, and strongly protests against the policy proposed to be substituted as quite inadequate to safeguard the clean areas in England and Wales, and as a policy which would ultimately be detrimental to the export trade in potatoes."

At the last meeting of the Agricultural Advisory Committee, which took place on the 3rd May, it was suggested, after some discussion, that consideration of the matter be postponed until the next meeting, when the Ministry will have had an opportunity of considering the Resolution of the Potato Advisory Committee.

(12) **Agricultural Improvement Regulations, 1922.**—It was reported to the Committee that Regulations, dated 9th March, 1922, had been

made varying the rates of interest to be paid under Section 3 (3) of the Agricultural Holdings Act, 1908, in respect of the execution of certain improvements by landlords, from 5 per cent. and 3 per cent. to 6½ per cent. and 4½ per cent. respectively.

(13) **Scheme for Scholarships, etc., for Sons and Daughters of Agricultural Workers.**—The Report of the Special Committee which had been appointed to draw up a scheme for "establishing scholarships and maintenance allowances for the sons and daughters of agricultural workers and others" under Section 3 of the Corn Production Acts (Repeal) Act, 1921, was communicated to the Committee. After discussion it was approved. The proposal of the Special Committee was to establish three classes of scholarships, one for the highest type at Oxford or Cambridge, or possibly other Universities, for three or four years; another for scholarships at Agricultural Colleges which would lead up to a diploma; and the third for scholarships at Farm Institutes or Colleges which carry on short courses. There were to be ten scholarships a year in the first class, ten in the second, and three hundred term-units in the third.

(14) **Proposed Amendment of Silver Leaf Order of 1919.**—It was suggested that the date, 1st April, by which the Order requires that dead and diseased wood should be cut out of fruit trees, be altered to the 15th September, and that the Ministry should strongly urge fruit-growers to carry out this work if possible during May and the first half of June. It was also urged that all reasonable protection should be taken by the application of Stockholm tar, grafting wax, or other suitable preparations to guard the cut surfaces of trees against reinfection by spores. These suggestions were made to the Ministry by the Horticultural Advisory Council at their meeting on 15th March, and were agreed to by the Agricultural Advisory Committee subject to the alteration of the date from 15th September to 15th October.

(15) **Encouragement of Co-operative or Travelling Dairy Schools.**—It was suggested that the Ministry's Scheme for supplying counties with facilities for starting co-operative or travelling dairy schools should be extended. The scheme was approved by the Committee, who agreed that it should be brought to the notice of County Councils.

(16) **Reports of Proceedings of the Various Advisory and Departmental Committees set up by the Ministry.**—Two reports were received by the Agricultural Advisory Committee outlining the work done by the other Committees of the Ministry. On the consideration of the last report, the question was raised as to the possibility of broadcasting accurate daily weather reports by wireless. The matter was already being considered by a Sub-Committee of the Agricultural Research Council, but it was promised on behalf of the Ministry that it would be separately looked into.

(17) **Agricultural Returns to be made Compulsory.**—A proposal that these returns, which had been made compulsory as a temporary measure during certain of the War years, should now permanently be made compulsory on occupiers of land, was considered and approved by the Committee. It was agreed that the Ministry would be well advised to proceed with a Bill to effect this object.

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CULTIVATION OF THE HOP CROP.

V.—PICKING, DRYING AND PACKING OF HOPS.

PART II.

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Hop Kilns.—Hops are dried in buildings which are called hop-kilns, several of which may be grouped together around a central cooling and packing floor. The collection of these buildings is called a hop "oast." The kilns in this country are generally constructed with brick walls, although in the Western States of America, where lumber is cheap, they are commonly built of wood. The roofs may be covered with tiles or slate and ceiled inside with plaster to make them air-tight, or alternatively may be covered with felt which is tarred annually for the same purpose.

Fig. 1 represents diagrammatically an open fire kiln such as is most commonly used in this country; such kilns may be circular or square, the former is rather more economical to build, but the latter is more convenient for use. The most convenient size is probably 18 feet square or 20 feet in diameter, with walls 18 to 20 feet in height, so that the drying floor, which is fixed about 4 feet below the top of the wall, may be at least 12 feet above the top of the fires. The floor consists of wooden joists and battens upon which is stretched a horse-hair cloth, resistant to the effects of heat; upon this the hops are spread for drying.

The roof slopes upwards from the top of the walls to an opening 3 feet or so in diameter. Above this opening is fitted a cowl C, swinging freely upon well-oiled bearings, so that each change in the direction of the wind causes it to swing round and allow a free escape of the air through its opening. The height of the cowl from the hair should be as great as possible (16 ft. to 18 ft.).

The fireplace or places are generally raised about 18 in. above the ground floor and are built to one of the outside walls so that they can be stoked from outside the kiln.

Hot-Air or Stove Kilns.—In normal hop drying the products of the coal fires must pass through the hops; any smoke, which may be produced, thus causes a taint in the hops, consequently only the best anthracite coal is permissible and this is expensive.

To enable the substitution of cheaper forms of fuel—wood in the Western States of America and coke in this country—various patterns of stove kilns have been designed which have the com-

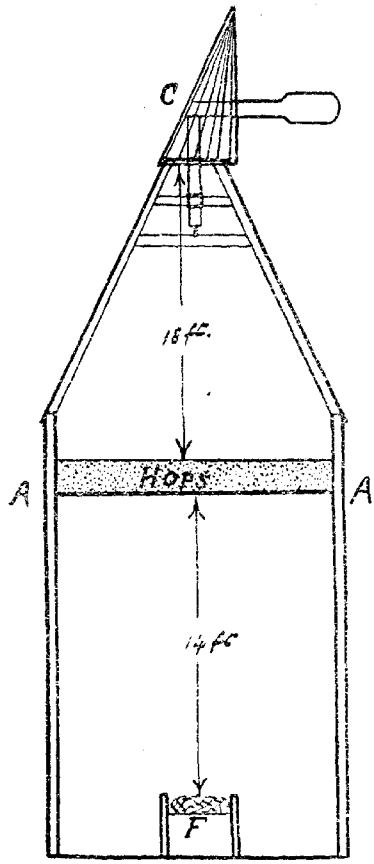

FIG. 1.—Hop Oast. F, fireplace; AA, drying floor; C, cowl.

mon property of a large area of heat-conducting surface by means of which the drying air is heated before passing through the hops; the stove is generally within the kiln and the products of combustion are led through a complex system of iron pipes below the drying floor before passing to a chimney through which the smoke, etc., is evacuated without passing through the hops.

The "cockle" kiln, now obsolete, was the most primitive type of these closed kilns.

In America closed kilns are everywhere used; they are generally built of wood and are higher than the usual English type of kiln. In England stove kilns are generally operated by artificial fan draught, the best known type being that designed by E. G. Shew, of Herefordshire.*

These stove kilns, as stated above, enjoy the great advantage of cheap fuel. In the Royal Agricultural Society's trials referred to below, it was shown that on the average of the seasons the output of dry hops per 1 cwt. of coke consumed was exactly 1 cwt., which compares favourably with the weight of anthracite coal commonly required for hop drying, generally regarded as between $\frac{3}{4}$ and 1 cwt. per 1 cwt. of dry hops, especially when the cost is taken into account.

The disadvantage of these systems is the extra capital involved and the rapid wear and tear to which the stove and pipes are subject. The labour involved in stoking such kilns is not greatly different from that in the open-fire kilns; the installation, therefore, of some such stove-kiln system is well worth the consideration of any grower who contemplates the erection of new oasts. The decision can be based upon prices prevailing at the time.

Other forms of hot-air drying have been tried in which the drying air has been caused to pass through a battery of pipes, heated sometimes by steam and sometimes directly from the products of combustion, situated outside the kiln. These types have not made much headway probably because of the inevitable wastage of heat involved.

Fan-draught.—The fan method of controlling draught has been applied both to stove kilns and to open-fire kilns in a variety of ways, and undoubtedly gives the drier absolute control in the oast. A drier provided with fan-draught and with thermometers should make no mistake, provided he takes reasonable precautions. There are several possibilities in the method of driving and utilising the fan; it may be belt driven or electrically driven and it may be placed above or below the hops. If the fan is belt driven it is generally situated below the hops to drive air into the kiln because it is more convenient to fix and drive in this way. When the fan is fixed below it is most important to provide adequate openings above the hops for the escape of the air since otherwise the fan is working against unnecessary resistance, but when kilns that have served for open-fire methods are converted, it not infrequently happens that this provision is omitted.

* An account of this and three other types of hot air kilns is given in "The Trials of Hop Drying Plant" in the *Journal of the Royal Agricultural Society* for 1909.

A further consequence of forced draught is the tendency for the products of the burning brimstone to be forced from the kiln throughout the oast, making the place untenable for the men engaged in "pressing," etc.; this is aggravated when sufficient outlets, mentioned above, are wanting. Very careful ceiling of the partitions between the cooling floor of the oast and the kilns is therefore necessary.

When the fans are electrically driven they can be fixed in any desired place and this is generally in the roof of the kiln some few feet (6 or 8) above the level of the hops so that the suction may not create a greater draught through the hops near the fan than elsewhere. In this position it is essential that the remainder of the roof area shall be very perfectly ceiled since otherwise any leakage of air through the roof will lessen the efficiency of the draught through the hops. By such an arrangement of the fan the difficulties associated with the interference of work by the fumes of the brimstone are, of course, obviated and it is generally found that drying is more uniform over the drying floor.

If the fans are used in association with open fires suction draught is the only form which can be applied, whereas with the closed stove it is immaterial whether forced or suction draught is utilised.

Source of Power.—There can be no question when a reliable source of electric power, as from an electric power company, is available that this will prove both most reliable and most economical. Where this is not the case either a portable steam engine or a fixed oil engine can be utilised to drive fans below the hops through a belt transmission. In some cases even it may be desirable where power is largely required for other farm purposes to drive the fans electrically from a fixed oil engine in some central position on the farm. Each case will need to be considered on its merits with the help of competent engineering advice.

Modifications in Drying Practice when Fan-Draught is Used.—*Loading.*—Generally when fan-draught is used, and provided the fan power and area of fireplace are sufficient, the load can be doubled and when hops are ripe the depth may amount to 18 in. to 22 in. Greater depths may be loaded and dried successfully but no useful purpose is served because the rate of drying is slow and the kilns cannot complete the drying of two loadings in 24 hours. When hops are unripe the load should be reduced

proportionately. With such deep loads it is most important to level the hops with the greatest accuracy upon the drying-floor.

Temperature.—Substantially the same range of temperatures applies for fan draught as for natural draught. There is the same danger of "reeking" at the beginning if the temperature rises too quickly, but this is not quite so acute because the power of the fan is equal throughout drying (as great at the beginning as at the end), whereas with the open fires the draught increases as the oast warms up. For this reason it is permissible to start drying at a temperature 5 or 10 degrees in advance of that recommended for open fire drying. That is to say a start may be made at 105° instead of the recognised 100° F. for open fires; but the temperature must not rise more rapidly with the fan draught and the same period must elapse before 140° F. is reached or misfortunes will arise in the shape of discoloured hops. Again the temperature may be raised to 150° or 155° F. after "feathering" to expedite the finish. Though this high finishing temperature is permissible, some careful growers place the maximum for fan drying at 140° or even 130° F. and by so doing contend that they retain more of the volatile oils and produce a softer textured sample.

Turning.—Fan-dried hops can be finished without turning just as hops over the open fires can be so dried, but undoubtedly turning expedites the finish and provided the operation can be done without undue smashing of the cones is a wise operation. From the nature of the case, however, with such a depth of hops on the floor it is not an easy operation. Where facilities permit, a trolley constructed to run backwards and forwards on runners above the hops enables turning to be accomplished without treading amongst them.

Control of Fires.—In the case of stove kilns the fan draught does not affect the combustion inside the stove, but where fan draught is associated with the open fire it introduces a disturbing factor because the quick draught causes the fires to burn through very rapidly and so necessitates much more frequent stoking and attention to ensure a steady temperature. A common fault with such kilns is the inadequate size of fireplaces. These should preferably be 3 times the area of similar fireplaces for the same kiln with natural draught; then the fires can be made up to burn more slowly and regularly and if the whole area of fireplace is not required it need not be used. Another consequence of fan-draught with open fires is the necessity of ensuring efficient mixing of the hot and cold air entering the

FIG. 2.—Baling Press, showing Hops pressed ready to close the bale.

FIG. 3.—Windlass for Pressing.

FIG. 1.—Showing False Floor and Coconut Matting for cooling deep layers of Dry Hops.

kiln, otherwise the air passing some parts of the drying floor may be 5 or even 10 degrees hotter than that at others. This mixing of the hot and cold air may best be attained by so arranging the stucture of each fireplace that large quantities of cold air can enter above as well as below the fire bars.

In addition to this a baffle-plate should always be supported immediately above the fireplace to prevent direct radiation from hot places in the fire to the drying floor. The baffle-plate should be supported upon perforated brickwork, constructed so that the perforations are very numerous and that the warm air can readily pass through the wall. Under these conditions it will not generally be necessary to let much cold air directly into the oast, except for purposes of cooling, and the mixing of the air as described will ensure uniform temperature.

Sulphuring.—When the fans are running the fumes of the burnt sulphur pass much more rapidly through the hops and therefore produce less effect; in view of this some people have advocated running the fans at a slower rate for the first hour whilst the sulphur is burning. This of course hinders drying and is therefore disadvantageous and may result in some precipitation of "reek" unless the temperature is down well below 100° F. Probably a better plan is to allow the fans to run at full speed from the start of drying and to allow larger quantities of brimstone to be burnt, amounting to 1 lb. to 20 or 30 sq. ft. of drying floor.

Control of Draught.—This is a simple matter. Usually the fans should be kept running at the maximum speed from the commencement to the end of drying except in the case when the hops are turned shortly before the finish. When this is done the resistance to the passage of the air is greatly reduced, less suction is necessary and the speed may well be slackened by 20 per cent., so that power and fuel may be economised.

Management after Drying.—When the hops are dry and cooled down to about 110° F. they are unloaded to the cooling and packing floor; in this operation great care must be taken not to break them unnecessarily or a "chippy" sample will result, for the hops are now extremely brittle. The best method consists in the use of false floors by means of which the hops can be unloaded without the necessity of handling them with scoop and broom. There are two such alternatives, the patent Hetherington floor, by means of which the drying floor cloth is wound off bodily to one side of the kiln and the hops drop down

during the process to a heap on the cooling floor, or small horse-hair "lifter cloths," 4 yd. by 6 yd., may be spread on the drying floor before each loading and lifted and discharged through the oast door at the finish. In the general case, however, no such false floor is available, and the hops have to be swept off the floor with scoop and broom, and are consequently liable to damage if roughly handled.

As soon as the hops are unloaded they should be spread abroad over the cooling floor nominally to cool, but much more importantly to re-absorb some water and become less brittle, so that when pressed into the hop-pockets they may retain their original structure without breaking.

In cases where natural draught kilns have been converted to fan-draught and the output of dried hops has been doubled without adding to the cooling floor, a considerable difficulty may arise in cooling the hops owing to the increased depth upon the floor; in this case delay may be occasioned in packing or the hops may have to be packed while still warm and brittle, thus occasioning both loss in quality and also in weight. This difficulty may be overcome by allowing access of air to the bottom of the heap, in which case the hot air amongst the hot hops rises and sucks the cool air in from below. The best way of accomplishing this is to construct a false wooden floor upon wooden runners about 6 in. high with 2 in. slats spaced 1½ in. apart. Upon such a false floor a depth of hops 3 or 4 ft. deep will cool as quickly as a depth 12 to 15 in. deep on a close-boarded floor. It is convenient to spread a loosely-woven cocoanut matting sheet over the false floor before unloading, so that the cool hops can be easily moved off the false floor for packing.

Packing.—Considerable judgment is required on the part of the drier so that his hops may be ready for packing in an ideal condition. They should be "home-dried," whole and soft to the touch with the requisite quantity of re-absorbed water. If by accident the hops have been unloaded before they were quite dry and contain a small proportion of hops with tough or sappy strigs they should not be spread abroad to cool but kept in a big heap and covered over with cloths so that the dry hops take up some moisture from those which are not dry. If they were dried too much they should be given extra time to cool and so to gain weight. On the other hand if left too long on the cooling floor in damp weather hops may absorb too much water vapour, in which case they become sour on keeping and are said to be "cold packed."

In England hops are pressed into tall cylindrical pockets for marketing, whereas on the Continent and in America the hops are universally marketed in rectangular bales. The former are awkward to handle, awkward to load upon wagons and on rail, and are by no means economical of labour in filling; the pocket has to be many times filled and the hops as many times slowly compacted with the foot of the press. The rectangular baling press, generally operated by horse power, completes the pressing in three or four operations and is much more expeditious. It is of course readily admitted that it is hardly possible to contemplate scrapping the circular presses indiscriminately, but it does seem desirable that the relative economy of the two methods should be carefully examined, and a useful purpose might be served if the Royal Agricultural Society, when it next meets near a hop-growing centre, offered a prize for the most economical design for power pressing.

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THE ORCHARDS OF MIDDLESEX.

C. H. MIDDLETON,
Ministry of Agriculture and Fisheries.

MIDDLESEX is one of the oldest if not the oldest of the country's commercial fruit-growing counties. Its proximity to the London markets, and the fertile alluvial soils of the valleys of the Thames and the Lea, have attracted fruit growers for many generations, and there is no doubt that in early days, when transport was confined to horse traffic, the Metropolis looked to Middlesex for the bulk of its fruit supplies. With the advent of modern transport, however, and the gradual overflow of Greater London into the best fruit districts, the county has lost many of its privileges, although it holds its own, and the cultivation of fruit is still a flourishing industry.

The old fruit-growing area of the county was the Thames Valley from Fulham and Hammersmith to Twickenham, including Chiswick, Brentford and Isleworth. The parishes of Isleworth and Brentford still contain some of the best orchards of the county, but during the past half-century the growth of the residential districts and the building of factories, the expiration of leases, and the increasing value of land, have pushed the fruit growers further west, and orchards have been planted over the extensive flat area, roughly 40 square miles in extent, of which the village of Feltham is about the centre. On the colder

and heavier soils of the northern half of the county very little commercial fruit-growing is attempted, except in the Enfield district of the Lea Valley, which contains some of the most productive orchards in the county. Here again, however, the activities of the builder, and the extensive brick-fields of the locality, are gradually crowding out the fruit grower and market gardener.

There is still plenty of room in West Middlesex for the development of fruit plantations, and with the excellent marketing facilities and favourable natural conditions, one might have expected the industry to increase and keep well up-to-date; but the facts are rather the reverse. The same markets and conditions are equally favourable to commercial vegetable growing, and while the latter has attracted new growers and gradually increased, fruit-growing appears to be steadily declining, or perhaps it would be more correct to say that the planting of young orchards is not keeping pace with the demolition of the old ones in the urban districts.

The Agricultural Returns give the following figures for Middlesex:—

	1910.		1920.		
	Acres.		*Acres.*		*Acres.*
Apples	1,115	...	998	decrease	117
Pears	438	...	262	„	176
Cherries	166	...	87	„	79
Plums	725	...	545	„	180
Mixed Orchards	2,901	...	3,103	increase	202
Total Orchards	5,345		4,995	Decrease	350 acres.
Small Fruits*	4,139	...	1,939	decrease	2,200

As regards fruit it will be observed that the only increase shown above is that of 202 acres of mixed orchards. This would be largely accounted for by the fact that orchards which originally consisted of one kind of fruit only have since been replenished with other kinds and become "mixed."

Many of the plantations are hopelessly mixed, and it is almost impossible to say what they consist of. Apparently for many years, as one tree has died, another, often of a different kind, has been planted, with the result that one finds, not merely mixed varieties of apples, etc., but apples, plums, and pears all mixed together without any ordered arrangement. On the other hand, plantations are by no means uncommon, which for uni-

* The acreage of land on which small fruit is grown under orchard trees is included both as small fruit and as orchards.

formity and systematic arrangement would compare favourably with any orchards in the country.

All the more popular hardy fruits, with the exception of strawberries, are well represented in the county.

Apples.—Middlesex has not always been regarded as an apple-growing county, but of late years the planting of apples has increased, with good results. The above figures, showing a decrease of 117 acres of apples, are slightly misleading when this fruit is considered alone, as in many of the mixed orchards apples are in the majority, and the probability is that during the period under review the actual area under apples was increased. Some of the older apple orchards are not now profitable, as too many old and unsuitable varieties are grown which might well be replaced with better and more profitable varieties.

Of the dessert varieties, Beauty of Bath, Gladstone, Worcester Pearmain, Allington Pippin, and Duchess Favourite do well in most parts of the county, while amongst the culinary varieties Lane's Prince Albert, Stirling Castle, Lord Derby, Bramley's Seedling, Ecklinville, and Newton Wonder, are equally at home. On the lighter soils of the Thames Valley most of the choicer dessert varieties do well. Between thirty and forty years ago the late William Whiteley planted a large model orchard at Hanworth, including many of the best varieties of apples, such as Cox's Orange Pippin, Ribston, and King of the Pippins, which are still in excellent condition and cropping well. The adjoining district of Hampton has also long been famous for its fine quality "Cox's," many of which annually give a good account of themselves on the exhibition tables. Further north at Heathrow, may be seen well-kept established apple orchards running into hundreds of acres, which are yielding good crops. They suffered badly during last summer's drought, owing to the light soils and rather exposed position, but generally the quality of the fruit compares well with that of any other district.

In some parts of the county James Grieve, Rival, Wealthy, and other modern varieties are now being planted.

Pears.—Pears are extensively grown in all the fruit areas of the county, particularly Hazel, Windsor, Clapp's Favourite, Fertility, Lammas, and other market varieties. It is a peculiarity of the Hazel (or Hessle) pear that it appears to do better in close proximity to large towns than in the open country. In the urban districts of Middlesex very old trees of this variety are still producing good crops of excellent quality fruit. Apparently much remains to be learnt as to the cropping qualities of pears, as

many unsuitable varieties have been planted at different times. For example, an orchard at Shepperton contains a large number of trees about fifteen years old which have never yet borne fruit. In later years, Conference, and other choice varieties have been planted more freely.

Plums.—The plum has been regarded as the most profitable crop in Middlesex. Many good incomes and probably a few fortunes have been made out of the Victoria plum. Unfortunately plums seem to have fallen on bad times during the past decade. The vagaries of the spring climate have made plum growing very risky, as wet frosts during the flowering period seem to have become more frequent in recent years. Add to this the terrible scourge of silver-leaf, which has killed thousands of trees every year, and one cannot feel very optimistic as to the future of plum growing in the county. Middlesex has probably suffered more from silver-leaf disease than any other part of the country. Of the Victoria plum trees planted twenty years or more ago roughly 60 per cent. are now dead or beyond recovery. The Agricultural Returns show a decrease of 180 acres of plums in ten years, but these figures indicate only a small proportion of the loss due to silver-leaf, because the plum orchards, although their acreage may have changed but little, have all been drastically thinned during the past ten years and the actual number of trees has been greatly reduced.

Since the Silver-Leaf Order of 1919 came into force something like 100,000 trees have been grubbed up, and the commercial growers are making serious efforts to keep the disease in check. There are, however, many difficulties to meet. Large areas of orchard land have been cut up for building, and the old trees, many of them diseased, are often hidden away in the back gardens of private houses, to be a constant source of infection to neighbouring orchards.

A cure for silver-leaf and a thorough regeneration of stocks may restore plum growing to its old prominence, but at present the outlook is anything but encouraging, and many growers are not replacing the lost trees.

The principal varieties grown are Victoria (the most profitable of all, but by far the most susceptible to silver-leaf), the Czar, Monarch, and Gisborne. Prince of Wales was once widely grown, but is not often planted now.

Cherries.—The cherry is no longer popular as a market crop in Middlesex. The official returns show a decrease of 79 acres during the ten years ending 1920. Of the remaining acreage, a

large proportion is made up by the batches of the Morello variety which are found in many of the larger orchards. Sweet cherries are not now grown to any great extent in the county but old, more or less derelict orchards here and there bear witness to the fact that cherry growing was at one time more popular. At Enfield in particular, "Cherry-Orchard Lane" together with an old orchard or two, and groups of ancient trees, remain to remind us of the days when cherry growing found favour in the district. Cherries, however, require a kindly season to bring them to perfection, and other crops are, no doubt, more reliable and profitable, with the result that cherries are not often planted now. Moreover, Middlesex does not possess a typical soil for this crop.

In the Slough and Langley district, which although just inside the Buckinghamshire boundary, is a continuation of the West Middlesex plain, there is a colony of several hundred acres of cherry orchards, where the industry is in a thriving condition, and young orchards are just coming into bearing. These orchards are of peculiar interest owing to the unusual system of letting. The land is owned by the Lord of the Manor of Langley, who has himself planted the fields with cherries. When the trees reach maturity they are let to growers, under conditions which include a certain amount of cleaning, manuring, etc., the owner letting separately or retaining for himself the grass under the trees for grazing purposes. Under this system the landlord is assured a fixed revenue, while the tenant harvests and markets his crop in the ordinary way, but requires practically no capital outlay. One of the results is that these orchards are among the best and cleanest of the country.

Undercrops.—Gooseberries, currants, and raspberries are grown as undercrops in many of the orchards, but in common with other fruits, their numbers have decreased during the last ten years. The greatest reduction is in black currants, which have in recent years been considerably injured by the currant mite (big bud). American gooseberry mildew has been responsible for the grubbing of large numbers of gooseberries, which are, however, one of the county's most reliable and profitable crops, and are again being freely planted.

In the western part of the county rhubarb and spring flowers are extensively cultivated under the trees. One large orchard, near Harlington, is entirely undercropped with peonies. Some of the orchards have no ground crops, but comparatively few are on grass.

Growers.—Middlesex has many first-class and up-to-date fruit growers, who have done much to improve the industry, and whose well-ordered plantations demonstrate the successful results of good husbandry. Unfortunately there are others whose cultural methods leave much to be desired, while a few have no methods at all, and rarely touch their orchards, except to gather the indifferent crop which the trees produce unaided.

It is only fair to add that many of these latter have mixed farms, fruit-growing being only one of their interests, and they cannot be expert in all branches. Further, the poor condition of many orchards is but a legacy of the late war: owing to the withdrawal of the necessary labour during the war period, many growers experienced great difficulties and were quite unable to keep their orchards clean.

In some cases, however, carelessness and lack of interest are evident, orchards being overcrowded and choked, and allowed to run entirely their own way. These growers have not observed the old saw, "a stitch in time saves nine." A clean orchard can be kept clean at a minimum of expense, but an accumulation of overgrowth and diseased wood so soon gets out of control that the orchard requires considerable capital outlay to get it into a productive condition again.

It is satisfactory to note, however, that during the past winter orchards have been thinned out and cleaned, and marked improvements are noticeable in many districts. Nevertheless, a great deal remains to be done in this direction, while spraying, grease-banding and other desirable operations are still the exception rather than the rule.

The fault appears to lie partly in the fact that some of the growers have "drifted" into the industry, without particular enthusiasm for it, with the result that technical knowledge has not developed. The real trouble, however, is undoubtedly the shortage of skilled labour. Fruit-growing, like any other trade or profession, cannot be successful without at least a leavening of highly skilled labour. Yet there are Middlesex fruit farms of a hundred acres where both owner and employees have not even an elementary knowledge of fruit growing.

It is fairly safe to say that *one* expert fruit grower to every fruit farm could double the output of high grade fruit. By expert is meant a man thoroughly and scientifically trained in all branches of fruit culture, who understands the principles of hygiene, and the management of an orchard from start to finish, including the grading, packing and marketing of the produce.

During the winter of 1920-21 two young apple orchards, which were on farms used as training centres for ex-soldiers, were utilised by Mr. J. Lawson, the Middlesex county instructor, who, by way of demonstration to the trainees, undertook to prune some of the trees. His treatment was thought by many to be too drastic, but his work was fully justified by last year's crop of fruit. Unfortunately only very approximate records were kept, and no figures are available; but as regards general appearance and quality of crop these two orchards stood out above any other similar orchards in the county. One orchard was visited by several interested parties, and some of the older growers expressed very high opinions of the crop. Doubtless the season would in any case have produced a good crop, but the result of Mr. Lawson's work was seen in the outstanding quality, size, and perfection of the fruit.

Crops of this kind ought to be, and could be the rule rather than the exception if there were sufficient skilled labour in the county, but the unfortunate fact is that few properly trained men exist at present, although the raw material is available. One frequently meets highly enthusiastic young employees on the fruit farms who if taken in hand by a capable instructor and carefully trained, could increase the value of their services tenfold.

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THE LARGE WHITE PIG.

SANDERS SPENCER.

ALTHOUGH some writers have essayed to describe the origin of the Large White breed of pigs, and one or two have even mentioned the names of two or three men who were interested in pig breeding some three score or more years ago as the founders of the Large White breed, it must be admitted that complete success does not appear to have attended their labours. Indeed, if a claim had been made some fifty years ago that there existed a distinct type of Large White pig it would have been most difficult to sustain it, for the simple reason that the white pigs found in Yorkshire and the adjoining counties had been so intermixed by the artisans and mill hands who were the most persistent and successful exhibitors at the many district shows, that it had become impossible to foretell with any degree of certainty the size and character of a resultant litter of pigs from the mating of white boars and sows.

In the sixties and early seventies the favourite system of mating was to select a thick fleshed boar of small size and with a short head, and to mate it with a sow of the largest size, possessing quality of bone, flesh and hair, a short face, and heavy jowls. As a rule there would not be the variation in size of the young pigs that might be anticipated, although later in life there might be a great difference in their development. The main reasons for this mode of procedure, which might not commend itself to pig breeders of the present day, were, that the fashionable pig of the period was one with a short head; that the wording of the prize schedules was usually "For the best white pig not exceeding certain fixed ages"; that the most popular pig classes were those for pigs not exceeding six or nine months old; that prize winning pigs in the classes for young pigs were always in great demand at good prices from agents and exhibitors at the Royal and other large shows; that those pigs not required for breeding could be readily made fit for slaughter either as fresh pork or as baconers as soon as the weather became cold enough; that as a rule the young pigs, the result of mating a small and compact boar with a large sow, possessed the outward appearance and character of the sire and also acquired the quick growth of the dam, and thus had a great advantage when shown in the classes for small white pigs, which then were probably the most fashionable type of pig and most readily sold at the highest prices.

It may appear strange to pig breeders of the present day that exhibitors of pigs should purchase at high prices pigs of such uncertain breeding which were almost sure to develop unevenly, but the conditions were quite different half a century ago from those existing to-day. In the first place there was no fixed type or qualification for Small, Middle or Large Yorkshires, as they were then termed. The pigs of all three breeds were supposed to have short heads; this was imperative with Smalls and Middles and almost universal amongst Large Yorkshires.

Mere size at the time of exhibition was the determining factor as to classification, so that it was possible for a white pig to pass and win as a Small Yorkshire when young and to develop so as to qualify subsequently for exhibition as a Middle White (or, as they were classified at the Royal Agricultural Society's show, as "a pig of any breed other than Berkshire, Small Black, Small Yorkshire, or Large Yorkshire"). Indeed it was declared that one pig was actually exhibited in all the three classes for White Yorkshires

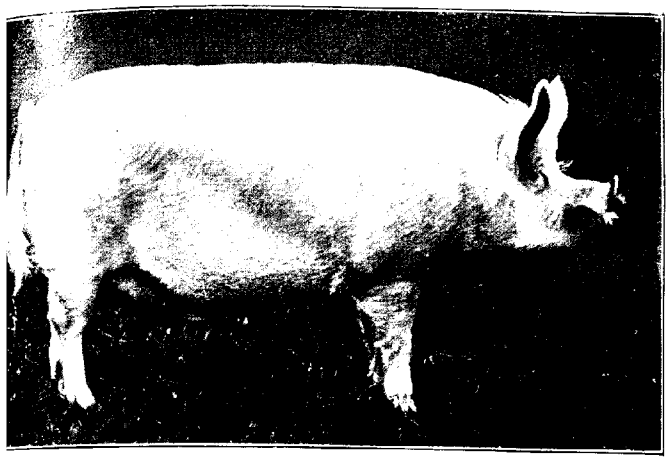

FIG. 1.—Large White Boar.

FIG. 2.—Large White Sow.

at different shows. It is within the knowledge of the writer that the same pig has won at the Royal as a Small Yorkshire and in the nondescript class, and that a pig has won in the latter class and then in later years has won as a Large Yorkshire. Any difficulty which might have arisen was easily overcome by entering a pig as "age and breeder unknown." This last practice had become so common, seven prizes for pigs so described having been won at one Royal show, that the buyers from the United States discussed the question in the American live stock papers and asked how any pigs of unknown descent could qualify in the classes for pigs of a defined breed and possessing a pedigree? This, and the difficulty, if not impossibility, of identifying white pigs and their breeders, were two of the chief causes of the establishment of the National Pig Breeders' Association some forty or more years ago. Some few years before the classification of Yorkshire pigs had been altered at the Royal Agricultural Society's shows, where prizes were offered for Small White pigs, Large White pigs, and Middle White pigs, and as scales of points had been drawn up, these with the registered pedigrees of the pigs entered, ensured to a considerable extent that the exhibits were accurately described and shown in the various classes. The comparatively short recorded pedigrees possessed by the pigs entered in the first few volumes afforded proof that the three varieties of Yorkshire pigs had not been bred on defined lines for any great length of time prior to the foundation of the herd book. Indeed it would be most difficult, if not impossible, to furnish proof that the Large White pig existed as a distinct and separate type before the seventies of last century.

About that period there was also a great change in the type of pig demanded by the purveyors of pork and especially by the bacon curers. Pigs furnishing a much smaller proportion of fat to lean meat were in more general demand. The introduction of the cold air system had enabled bacon curers to carry on operations with as great ease during the summer months as during winter, so the necessity ceased for salting heavily the bacon intended for consumption during the summer. The necessity for bacon pigs carrying a large proportion of fat to lean also ceased when the mild-curing system became possible with the aid of the cold air chambers. With the passing of the heavily salted lean portion of the bacon there sprung up an enormously increased demand for what has been termed "breakfast bacon," *i.e.*, lightly cured bacon carrying comparatively little fat and manufactured from pigs long in the carcass and thus affording the largest possible proportion of the middle portion of the side of bacon.

The bacon curers in these islands gave free expression in the public press to their requirements as to the form and degree of fatness of the pigs for which they were enabled to pay the highest price, so that the breeders of the various kinds of pigs had placed before them a model to which they might work up. The general body of pig breeders did not seem inclined to make any great alteration from the type of pig which they had been breeding, but one or two breeders of Large White pigs were apparently impressed with the fact that with some modification their favourite breed of pig could be made so that it would qualify as a bacon curer's pig. The jowl was lightened, the shoulders were made much lighter, the lean meat increased, the bone was made of finer quality, the form of the ham was improved and the quantity of fine hair increased. In the seventies of last century the Large White was a large pork pig, in the eighties and nineties it was a bacon pig. The so-called improved Large White and its crosses were tried by the home curers with satisfactory results; the bacon placed on the London and Manchester markets complied so much more nearly with the requirements and fancies of the consumer than did the imported bacon, that the manufacturers of bacon in Denmark purchased a considerable number of large white boars from a large herd in the Midland Counties. The results were so satisfactory that the Canadian curers sent orders for breeding pigs of the Large White breed to the same breeder. Eventually exports of Large White pigs of this distinct type were made to all those foreign countries where bacon curing is carried on to any extent.

The Large White pig had become so popular that foreigners whose native pigs were far too small and short, purchased at prices which were at the time considered to be exceedingly high, the largest pigs of the breed, those which were long in the face and high on leg. Unfortunately, owing to this, a large proportion of the breeders of Large Whites followed the example of the Berkshire breeders by studying the requirements of this limited proportion of the buyers of pure-bred pigs whose wants were of a special character, and by so doing rendered their pigs of considerably less value to the greater portion of their customers whose demands were for smaller fine joints from pigs which developed early. The breeders of Berkshires have restored their pigs to public favour and usefulness and there are clear signs of an awakening of the breeders of Large Whites to the fact that although fancy points help to sell a few pigs at high prices for a short period, the commercial market is of greater import-

ance and is more continuous. The number of breeders of Large Whites does not appear to have increased in recent years.

Although the sows of the Large White breed are at least the equals of sows of any other breed or cross in prolificacy, in milking, and in the general duties of motherhood, the strongest claim for popularity of the Large White pig probably rests on its wonderful capacity for crossing on pigs of almost any breed and rendering the joint produce suitable for the wants of the bacon curer. At the present time it is declared that no breed or cross of pigs so nearly supplies the wants of the manufacturer of the bacon which realises the highest price on our best markets and which is in the greatest demand than does the cross-bred pig produced by a Large White boar and a Large Black sow.

The National Pig Breeders' Association has published what is termed a standard of excellence which may be of some value but which might perhaps be of still greater assistance if the market and breeding value of each point had been stated. It is as follows:—

Colour.—White, free from black hairs and as free as possible from blue spots on the skin.
Head.—Moderately long, face slightly dished, snout broad, not too much turned up, jowl not too heavy, wide between the ears.
Ears.—Long, thin, slightly inclined forward and fringed with fine hair.
Neck.—Long and proportionately full to shoulders.
Chest.—Wide and deep.
Shoulders.—Level across the top, not too wide, free from coarseness.
Legs.—Straight and well set, level with the outside of the body, with flat bone.
Pasterns.—Short and springy.
Feet.—Strong, even and wide.
Back.—Long, level and wide from neck to rump.
Loin.—Broad.
Tail.—Set high, stout and long, but not coarse, with tassel of fine hair.
Sides.—Deep.
Ribs.—Well sprung.
Belly.—Full but not flabby, with straight underlines.
Flank.—Thick and well let down.
Quarters.—Long and wide.
Hams.—Broad, full, and deep to hocks.
Coat.—Long and moderately fine.
Action.—Firm and free.
Skin.—Not too thick, quite free from wrinkles.
Objections.—Black hairs, black spots, a curly coat, a coarse mane, short snout, inbent knees, hollowness at back of shoulders.

Large bred pigs do not fully develop their points until some months old, the pig often proving at a year or 15 months a much better animal than could be anticipated at 5 months and *vice versa*, but size and quality are most important.

THE CONTROL OF MAGGOTS ATTACKING THE ROOTS OF VEGETABLES.

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INSECT pests of vegetables have been very much neglected by research workers in this country, especially insects attacking onions and carrots, and to a less extent those injuring cabbages and turnips.

Cabbage Root Fly.—In America, where pests of vegetables receive much more attention, efforts have been made to devise a satisfactory means of control for the maggots of *Chortophila brassicae*, the cabbage root fly, which attack the roots of cabbages, cauliflowers, turnips, etc.

One of the methods of control recommended is the device known as the tarred felt "disc," which consists of a small square of ordinary tarred roofing felt which is slit in the manner shown in the diagram.* These squares are placed round the stem of the plant at the time of planting out in the field and act mechanically in preventing the fly from laying her eggs on the plant. To place the square in position, the main slit is opened and the two flaps in the centre are lifted up; it can then be slipped round the stem and pressed down close around it. The squares must lie flat on the soil to be correctly applied, and the soil should be in a friable condition to enable them to do so. They should be about $2\frac{1}{2}$ in. square and can be cut from a sheet of tarred felt with a sharp knife. It is important that the material used should be tarred roofing felt and not the thin paper sometimes sold as felt.

As regards preventive measures for this fly by means of chemicals, good results have been obtained by using ordinary creosote applied to the plants, mixed with some substance like dry soil or precipitated chalk to act as a "carrier" or "spreader" of the creosote. It is inadvisable to use sand as the spreader because it does not absorb the chemical. The proportions should be two parts by weight of creosote to ninety-eight parts of chalk or earth. If possible precipitated chalk should be used as the spreader, as it takes up the chemical readily, is easily applied, and is cheap. In order to obtain the correct proportions of the mixture it is better to weigh out the respective

* See also this *Journal*, April, 1918, p. 59.

amounts of creosote and chalk. A quarter of an ounce of creosote to 12 oz. of chalk gives the correct proportion, and in recent trials it was found that 2½ lb. of the mixture was sufficient for each square rod (or, say, 30 square yards). To mix the two together, the chalk can be put into a tin bath or similar receptacle and the creosote added slowly, the chalk being continuously stirred. The mixture should be applied in spring after the plants are set out, being dusted round the seedlings by using either a powder sprayer or a strong paper bag with a hole in one corner. Two or three applications should be given at fortnightly intervals.

A third method of control, which has given good results in America is treatment with *corrosive sublimate*. A solution of 1 oz. in 10 gal. of water should be made, and as the sublimate requires a little heat to make it dissolve, it should be dissolved first in a small quantity of hot water and then made up to ten gallons. As it is poisonous it should be used with care. About a tea-cup-full should be applied to each plant as soon as the plants are set out, and four applications given at intervals of a week or ten days.

Onion Fly.—The onion fly (*Hylemyia antiqua*), like the cabbage root fly, usually lays its eggs upon the plant and not in the soil. Any chemicals used as insecticides against this fly should be in the nature of deterrents to keep the fly away and prevent it laying its eggs, as once the maggots have got into the bulb of the onion it is too late to eradicate them. No such mechanical device as the tarred felt disc is practicable, however, and we must look to other measures for its control.

Experiments have been made with varying success. The worst damage is done when the onions are in the seedling stage, as the maggots are capable of killing several onions by migrating from plant to plant. Any insecticide must therefore be applied in early spring soon after the onions appear above the ground. It is recommended that the fields be dusted in early spring, when the onions are two inches long, with a mixture of dry earth or precipitated chalk and green tar oil, in the proportions of one part by weight of oil to ninety-nine parts of chalk or dry earth (say ¼ oz. to every 1½ lb. chalk). Several applications should be given at intervals of a fortnight. The materials may be mixed and applied in the same manner as for cabbage root maggot.

The corrosive sublimate solution used against the cabbage root maggot is well worth trying in this case also. Soot, which

is so often recommended as a remedy for the onion fly, has proved entirely inadequate.

Heavy applications of nitrate of soda or of some similar stimulant have been found in practice to prove very beneficial in enabling the onion to withstand attacks by the onion maggot. In recent experiments it was found that of two exactly similar plots of onions, one of which was treated with nitrate and the other left untreated, the former gave 64 lb. of clean onions as compared with 32 lb. on the latter.

Carrot Fly.—For the carrot fly (*Psila rosae*) remedies must be applied early in the season when the carrots are a few inches long and before the fly lays her eggs. The chief point of difference between the life history of this insect and that of the onion and cabbage root flies lies in the manner of egg-laying, the eggs being deposited in the soil and not on the plant. Bearing this fact in mind it will be seen that if the soil is dusted over with a thin covering of chalk or earth impregnated with some insecticide, the fly is likely to be deterred from egg-laying, while even if the egg is laid, the tiny maggot may be killed by the chemical on its journey from the egg to the carrot root. In practice it was found that green tar oil, chlor-cresylic acid, or nitro-benzene, gave the best results, when applied mixed with precipitated chalk at the rate of $\frac{1}{4}$ oz. of the chemical to $1\frac{1}{2}$ lb. of the chalk. It should be mixed and applied as in the other cases.

In captivity the carrot fly has shown a very great fondness for sugar and will continue to feed upon it till the abdomen bursts and the insect dies. It might be worth while in gardens and allotments to put out a small quantity of syrup or molasses to attract the flies away from the carrots. Whenever possible carrots should be sown late, about the end of the first week in May, as by this means the first generation of flies is avoided and the risk of infection thereby lessened.

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The Sex of Eggs.

INVESTIGATIONS into a means of increasing the proportion of hens to cocks in hatchings were described in a communication by M. Lienhart of the University of Nancy,* made to the Académie des Sciences in 1919.

Starting from the facts that in the same breed cocks are heavier than hens, that the weight of young male chickens is higher than that of females, and that the same difference is perceptible even in newly-hatched chicks, it occurred to Mr.

* See *Journal d'Agriculture Pratique*, 14th Aug., 1919.

Lienhart that the eggs from which male birds are developed might also be heavier than those producing females.

Experiments which he then made did appear to show that by selecting for incubating eggs heavier than the average a larger proportion than usual of male birds was produced. This was only the case, however, when eggs of a single pure breed were used, and it appeared that the result would be more certain if eggs were used from fowls all of the same age and at the height of the laying season.

Further experiments at the Experimental Station of Ccligny (France) have given the following results* :—

Sitting of 15 eggs,	medium weight,	rather light,	8 hens,	4 cocks.
„ „ 15 „	„ „	„ heavy,	4 „	7 „
„ „ 15 „	all heavy		4 „	9 „
„ „ 15 „	light weight (below average)		9 „	3 „
„ „ 15 „	(from 5 hens) lightest weight		11 „	2 „

Other experiments gave negative results and M. Lienhart found† that these were always obtained with breeds of mixed origin, such as Faverolles, Mantes, Coucous de Malines, etc. With Leghorn, Minorca and Bresse eggs, a large proportion of males with heavy eggs, and a large proportion of females with light eggs, were always obtained.

In reality, the progenitors of the Faverolles had very different weight averages of eggs :—Houdan 1.94 oz., Brahma 1.87 oz., Dorking 2.19 oz. It follows that certain families of Faverolles have eggs approaching Houdan eggs, others Brahma eggs, and others again Dorking eggs. If then, light Faverolles eggs (average weight 2.12 oz.) are selected to obtain females, one may include in the sitting heavy eggs of the Houdan type or Brahma type and consequently obtain males. With eggs from a single Faverolles hen, however, of which the eggs were of a constant average weight, M. Lienhart obtained a majority of males with the heavier weights and vice versa.

These results are sufficient to encourage further investigation into the possibility of making, under practical conditions, such a selection of eggs for sitting that a large proportion of the sex desired may be obtained.

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* *Journal d'Agriculture Pratique*, 25th Feb., 1922.
† *Bulletin de la Société de Biologie*, No. 36, 10th Dec., 1921.

Plans for a Goat House.

CONSIDERABLE interest was shown in the Ministry's exhibit at the last National Utility Poultry Society's Show, of a model house for two goats and a fodder store combined. The model was designed to illustrate how goats could be housed under the most hygienic conditions with due consideration to economy of space and material. Detailed plans of the model have now been prepared and copies may be obtained from the Offices of the Ministry, 10 Whitehall Place, S.W.1, price 3d. post free.

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NOTICES OF BOOKS.

Crops and Tillage.—(J. C. Newsham, Principal of the Monmouthshire Agricultural Institution, Usk; pp. 182; 6s. net: Methuen & Co., Ltd. London.) This is a textbook which should attract a wide range of readers. It is written in a manner which must appeal to the farmer, and particularly to the farm student, yet it may also be described as a book for the University student who, after reading extensively, desires to focus his knowledge of the subjects coming within its title. In handling a scientific subject there is always the problem of technical words, but the writer manages to make his statements clear, without labouring to explain their evident truth when such would involve a standard of scientific training beyond that of the readers for whom the book is intended. The information is well knitted together, as, for example, in the description of the development of rotations as now practised, and the reader finds himself more and more interested as the subject matter is unfolded. The writer's experience is wide and drawn from many districts, and the book should prompt the farmer to try methods of cultivation which have proved successful elsewhere than in his immediate neighbourhood. Points of practical interest to the farm student, such as occur for example in threshing, stacking, sowing, rolling, in fact, in the most everyday operations, are dealt with in a manner most likely to impress the memory. Being recently written, the book embodies much of the experience, and many of the lessons of war-time cultivation. The writer wisely introduces much information which a farmer, from its very familiarity, often never thinks of explaining to a pupil. The index is good, but is unfortunate that it is not fuller. Several references are made to experiments, and to the works of agricultural writers, but a brief list of books of reference would have been an advantage. The pages on grassland and its problems are very good and give a well-balanced summary of the writer's experience, incidentally, it may be noted, he urges the value of liming rough pasture previous to the application of slag if the best results are to be obtained. Perhaps more might have been said about weeds without stepping beyond the title of the book. Several insect pests are touched on, and some fungus diseases. On points like these a list of references would have been useful and would not materially have increased the number of pages.

Commercial Poultry Farming.—(T. W. Toovey.) It is now three years since the first edition of Mr. Toovey's book was published, and the present edition has been entirely rewritten and many additional illustrations have been included. A book of this nature cannot fail to be of great value to all interested in commercial poultry farming, as it contains in detail and in a very clear manner the methods employed at the King's Langley Poultry Farm. Mr. Toovey has devoted many years to the study of this branch of agriculture, which is a growing an important one in this country.

In recent years commercial egg farms have sprung up all over the country, but in nearly every case they have been modelled more or less on the methods employed in the United States and Canada, altered somewhat to suit climatic variations on this side of the Atlantic.

Mr. Toovey's system departs largely from the usual practice, and in many ways may be said to be unique, especially so with regard to what are perhaps the two most important branches, namely, hatching and rearing, on which the success of a poultry farm so largely depends. Some 6,000 head of laying stock are run on this farm and the whole of the hatching and rearing is carried out by means of broody hens. To those unacquainted with the excellent arrangements made by Mr. Toovey this method of hatching may appear a difficult task, as indeed it would be were it not for his system and the fact that a considerable proportion of the stock consists of "heavy" or sitting-breeds and first crosses.

Two other items in Mr. Toovey's management also differ considerably from the usual practice. The runs are entirely of grass and the soft mash feed contains a high proportion of vegetables, a part of the farm being set apart for their cultivation. The large scratching house system is employed for accommodating the breeding and laying stock, but the unit per house has been kept down to 150 head in the case of unmated flocks and 75 for breeding stock. The breeding stock have separate wired-in runs but the laying stock amounting to some 5,000 birds are given free range in one large paddock. Mr. Toovey has rendered great service to the poultry industry in the past by the very frank way in which he has contributed to the Press, relating not only his successes but the failures which he has at times encountered and successfully overcome. In particular the two last chapters in Mr. Toovey's book should be read by every intending poultry farmer. These two chapters deal with the economics of poultry keeping based on the author's experience, and also express his views as to the future part to be played by the poultry industry in general agriculture. These views should prove of considerable interest to British agriculturists.

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Agricultural Research Scholarships.—The Ministry invites applications for research scholarships in agricultural science. The number to be awarded will depend upon the qualifications of candidates and will not in any case exceed five. The scholarships are tenable for three years from 1st October, 1922, and are of the value of £200 per annum.

Applications must be received not later than 15th July, 1922, and must be made on the prescribed form, which, together with a copy of the conditions attaching to these scholarships, may be obtained from the Secretary, Ministry of Agriculture, Whitehall Place, S.W.1.

Fream Memorial Prize.—The Fream Memorial Prize, which is annually awarded by the Ministry to the candidate who obtains the highest marks in the examination for the National Diploma in Agriculture, has been won this year by Mr. Robert Laird of Lawthorn, Irvine, Ayrshire, a student of Glasgow University and the West of Scotland Agricultural College. The value of the prize this year is about £6 10s., which is to be devoted to the purchase of books.

Report of International Seed Testing Congress.—Copies of the Report of the International Seed Testing Congress which took place at Copenhagen in June, 1921, will shortly be obtainable from the Secretary, National Institute of Agricultural Botany, Huntingdon Road, Cambridge. The price of the Report will be 6/- post free.

All those who propose to purchase copies should send their orders accompanied by a cheque or Postal Order to the above address as soon as possible, as the supply is limited.

Leaflets issued by the Ministry.—Since the date of the list given on page 188 of the May issue of the *Journal*, the following leaflets have been revised, and the one marked with an asterisk will, provisionally, be supplied free :—

No. 141.—The preparation and packing of Honey for Market.
" 244.—The Destruction of Rats.
" A 316/1.—Abridged List of Publications.*

The following leaflets are no longer supplied free :—

No. 381.—How to keep Swine Fever away.
" 383.—Hints on Goat-keeping.

Foot-and-Mouth Disease.—Since 23rd April, the date referred to in the Note contained in the *Journal* for May, 1922 (p. 103), only 16 further outbreaks of Foot-and-Mouth Disease have been confirmed in Great Britain, bringing the total up to 21st May to 1,099, of which 994 were in England, 3 in Wales and 102 in Scotland. Of these 20 outbreaks 1 occurred in Cheshire, 5 in Derbyshire, 1 in Denbighshire, 2 in Staffordshire, 8 in the West Riding of Yorkshire, 2 in Berwickshire and 1 in Midlothian. All these cases were dealt with by slaughter of the affected animals and those immediately in contact, involving the slaughter of a total of 401 cattle, 320 sheep and 122 pigs in the 20 outbreaks.

The outbreaks in Berwickshire and Midlothian occurred in free districts, and involved the reimposition of restrictions over an area of 15 miles radius from the infected centre. One of the outbreaks in Staffordshire and 1 in the West Riding, were near the border of a scheduled area, and involved small extensions of the areas under restrictions. Two of the outbreaks, viz. in Denbighshire and Midlothian, occurred on premises which had been previously infected but were freed and re-stocked.

Since 23rd April further modifications of the restrictions on the movement of animals have been made by Orders freeing large parts of Fife, Lanark, Renfrew, Westmorland, Cheshire, Norfolk, Lincolnshire (Lindsey), Lancashire, and parts of the 3 Ridings of Yorkshire, also freeing small areas in Northumberland, Cumberland, Essex, Middlesex, Perthshire, Forfar, Dumbartonshire, Durham, Nottinghamshire, Leicestershire and Warwickshire.

The following statement gives the number of outbreaks which have occurred since the commencement of the epidemic in January last up to 21st May, 1922, the date of the last outbreak in each county, the number of infected premises which have been declared free, and the number of animals slaughtered in each county.

County.	No. of out-breaks	No. of out-breaks freed.	Date of last out-break.	Animals slaughtered.			
				Cattle.	Sheep.	Pigs.	Goats.
England.							
Bedford	1	1	3/2/22	44	—	—	—
Buckingham	1	1	2/3/22	8	—	—	—
Cambridge	2	2	8/2/22	82	—	61	1
Chester	43	41	26/4/22	1,214	48	180	—
Cumberland	5	5	25/2/22	303	80	—	—
Derby	17	6	21/5/22	313	1	35	—
Durham	75	73	8/4/22	1,190	409	215	8
Essex	16	13	29/3/22	325	537	384	—
Hants	1	1	7/2/22	5	—	—	—
Kent	3	3	3/3/22	57	163	1	—
Lancaster	105	98	6/4/22	1,723	141	838	2
Leicester	3	2	2/3/22	221	35	1	—
Lincs., Lindsey ...	33	33	21/3/22	825	1,745	358	—
do. Kesteven ...	1	1	2/2/22	17	25	—	1
London	2	2	17/2/22	39	—	—	—
Middlesex	6	3	9/4/22	198	—	155	—
Norfolk	23	23	26/3/22	576	161	488	3
Northumberland ...	38	37	17/4/22	1,200	508	186	—
Nottingham	20	19	28/3/22	372	159	86	—
Salop	1	1	1/2/22	41	—	1	—
Stafford	9	5	11/5/22	173	43	87	—
Suffolk	5	5	17/2/22	118	—	101	—
Surrey	1	1	9/2/22	—	—	—	—
Sussex, E.	1	1	21/2/22	—	—	—	—
Warwick	2	1	12/4/22	134	175	81	—
Westmorland ...	24	20	1/3/22	317	390	46	
Yorks, E.R.	180	159	17/4/22	3,099	10,761	2,435	5
,, N.R.	104	90	11/4/22	2,759	2,736	841	2
,, W.R.	272	246	11/5/22	4,390	446	2,081	15
Total	994	893	—	20,043	18,862	8,664	37
Wales.							
Denbigh	3	2	26/4/22	43	—	14	—
Total	3	2	—	43	—	14	—
Scotland.							
Berwick	8	4	15/3/21	105	926	11	—
Dumbarton	4	4	16/3/22	105	61	29	—
Dumfries	1	1	4/2/22	84	—	1	—
East Lothian ...	3	3	16/3/22	108	—	25	—
Fife	8	6	13/3/22	226	1	19	2
Forfar	23	14	18/4/22	381	617	268	2
Kinross	1	1	23/2/22	13	—	1	—
Lanark	9	9	3/3/22	101	6	49	1
Linlithgow	1	1	11/2/22	13	—	—	—
Midlothian	11	9	14/3/22	911	—	174	1
Perth	10	9	21/3/22	435	107	23	1
Renfrew	16	14	4/3/22	291	16	47	—
Sterling	7	7	20/2/22	151	—	3	—
Total	102	81	—	2,960	1,734	650	7
Grand Total for Great Britain ...	1,099	976	—	23,067	20,596	9,328	44

Rabies.—*Southampton.*—A case of Rabies in a dog at Itchen, in the Borough of Southampton, was reported to the Ministry on 5th May. The head was received at the laboratory, and the case was confirmed on the 9th instant.

The dog, a fox terrier puppy, 7 months old, was not known to have bitten any other animal or any person. The owner states that he exercised the dog for miles over the country in the Southampton neighbourhood where outbreaks of Rabies occurred during 1920 and 1921. It is considered a possibility that infection may have been contracted from a rabid dog of the last series of outbreaks by some other dog, and communicated by a bite to the puppy now affected. No further information is available at the moment, but inquiries are being pursued as to any dogs lost or destroyed during the past 6 months.

An Order was made on 9th May, requiring the muzzling of all dogs within a radius of 15 miles from Southampton, and prohibiting the movement of all dogs out of that area except by licence of the Ministry. No licences will be granted except under conditions requiring the dog to be detained and isolated for 6 months on the premises of a veterinary surgeon approved by the Ministry.

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